MAGINOT LINE GUN TURRETS

And French gun turret development 1880–1940

CLAYTON DONNELL

ILLUSTRATED BY DONATO SPEDALIERE

NEW VANGUARD 250

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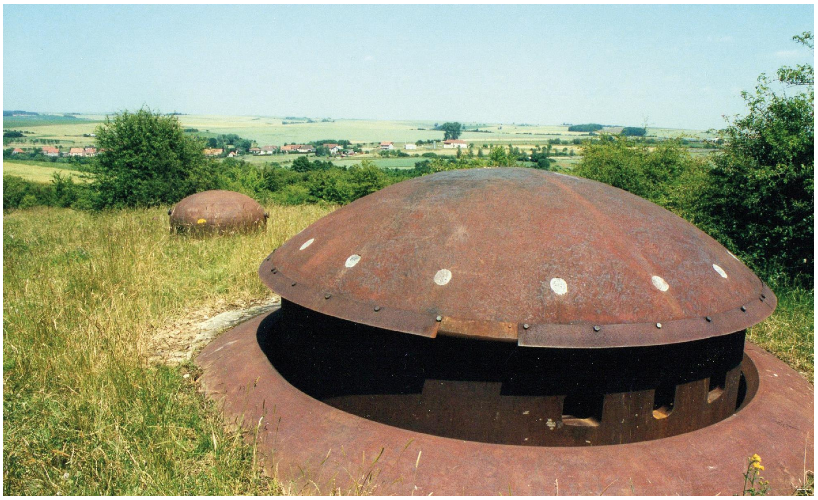
MAGINOT LINE GUN TURRETS

AND FRENCH GUN TURRET DEVELOPMENT 1880–1940

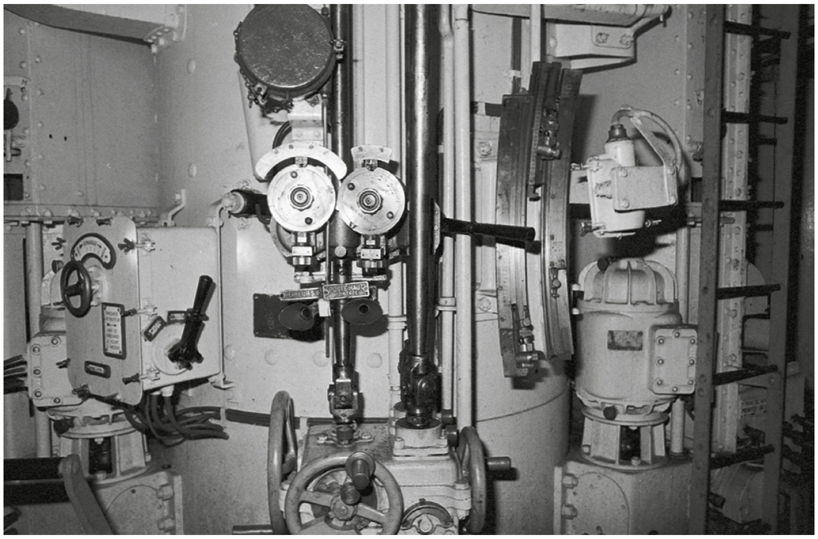
INTRODUCTION

In any discussion of the Maginot Line, the key question is always asked: was the Maginot Line a success or failure during the Battle of France in 1940? The answer depends on perception of the role the line was intended to play. If one believes the Maginot Line was built for the primary purpose of stopping a German invasion of France, most will consider it a massive failure and a waste of money, because it did not achieve this. In reality, the line was not built to be the ultimate saviour of France, although too many Frenchmen at the time believed it to be so, thus giving them a very false sense of security and resulting in subordination of the offensive spirit of 1914. Rather, it was assigned a series of minor yet crucial roles, all of which were fulfilled. The problem with the Maginot Line is that it was not used as it should have been by the French army. Nevertheless, theory aside, its engineering was outstanding. Based on its proven performance, in particular its armoured gun turrets, one can only conclude that the Maginot Line was a remarkable weapon, and that is what we will discuss here.



The mixed-arms turret of *Ouvrage du Welschoff*, Fortified Sector Rohrbach. The cloche GFM Type B is in the background. (Author's collection)

The armoured gun turret – a revolving compartment driven by a motor that fits into a circular well – has been around for a long time and it still exists in several forms today, primarily mounted on tanks and ships. The turret was first developed to protect guns and gunners as artillery became more accurate and powerful. A typical model revolved 360 degrees with its guns adjustable to fire at various angles. The first French armoured gun turrets were built primarily for land-based fortifications, because, from 1870 to 1940, the French were fighting for their lives and their territory against a powerful and aggressive German empire. The French were constantly building and being forced to modernize what they had just built.



Bloc 5 of *Ouvrage du Monte-Grosso* in the Alpes-Maritimes in 1983. The turret was restored by the French liberation forces and took part in combat against the Germans on the *Plateau d'Authion* in October 1944.
(**Wikimaginot.eu** Collection)

The first French gun turrets began as 'revolving turrets', but they evolved into a retractable model, a feature that made them different from those of other European countries. The original designs were tough, made of cast iron and steel that stood the test of fire, but the only way to protect the gun embrasures was to turn the guns away from the direction of enemy fire. Colonel Bussière, a French engineer, turned them from simple to sophisticated. Bussière designed the first retractable turret, the *tourelle à éclipse,* that enabled the turret to drop below the surface of its concrete housing to mask the embrasures. His idea evolved into the excellent designs found in the French forts of World War I and later the Maginot Line.

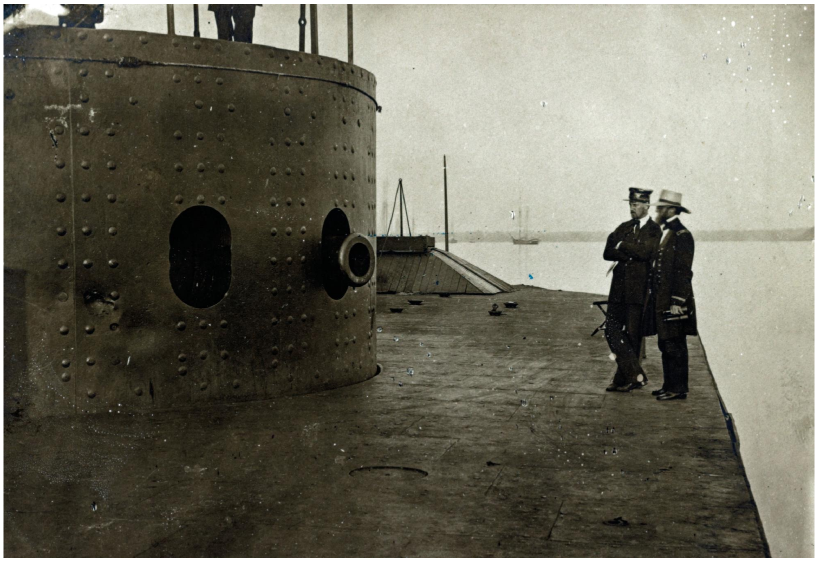
Despite a rough start in 1914, after which they were virtually emptied of their garrisons and stripped of flanking weapons, the French forts redeemed their value during the battle of Verdun. The earlier turrets performed well despite being hit by a massive number of heavy-calibre German shells, up to and including 420mm. Their engineering concepts also proved to be very reliable and durable. The engineers of the Maginot Line adopted and further perfected these designs, creating magnificent weapons that proved their worth during the German onslaught in 1940.

The guns were operated by professional, highly trained teams – *Équipes* – who followed very tight procedures similar to those used in French naval vessels. As turrets had their origins on naval vessels it is no surprise that the forts of the Maginot Line were compared to land-based ships. They were swift to intercede and very accurate, and remained a thorn in the German side throughout the campaign.

DEVELOPMENT OF FRENCH ARMOURED TURRETS: 1870–1940

Pre-Maginot Era (1870–1914)

Since ancient times the science of fortification engineering has been a constant seesaw battle between attack and defence. For France, the Maginot Line gun turrets were the culmination of this battle – the ultimate armoured protection of both gun and gunner from increasingly powerful enemy artillery shells, with the ability to strike the enemy quickly, powerfully and accurately. The final product, the armoured gun turret – a revolving cylindrical compartment for one or two guns of various sizes and missions – was an offshoot of the concept of using armoured masking to protect guns in land and coastal defences. The British coastal defences in particular incorporated armour into their coastal gun ports. In 1855 the British navy's Captain Cowper Coles proposed the development of the first rotating armoured turret for the protection of naval guns. The proposal was rejected by the Admiralty but in 1860 the Swedish inventor John Ericsson developed an armoured turret for the American Union navy's ironclad gunboat *Monitor*.

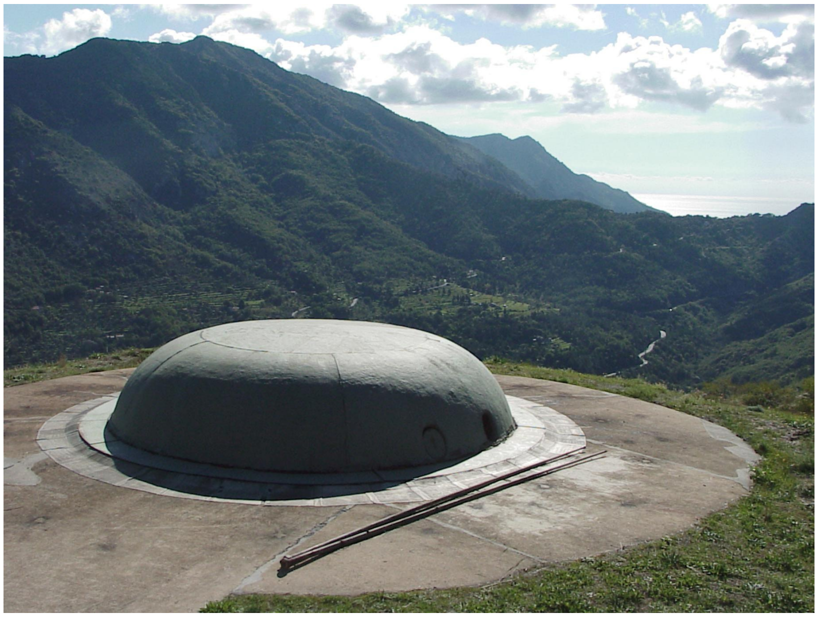


The Ericsson turret on the Union Navy ironclad USS *Monitor*. The turret was based on the design by British Navy engineer, Captain Cowper Coles. (Author's collection from US Library of Congress)

From 1852 to 1865, Belgian General Henri Alexis Brialmont, one of Europe's greatest military engineers, conducted tests at Antwerp on various types of armour plating. In 1863, the first revolving turret, armed with two 240mm cannons based on the plan of Captain Coles, was installed at Antwerp's Fort No. 3. In 1865, Captain Schumann, a Prussian army engineer, went to Antwerp, observed the Coles turret and began a series of experiments in Mainz and Berlin that culminated in 1870 with the presentation of his own design. The *Schumann turret* was manufactured by the armaments division of Grüson (later acquired by Krupp). Built to house a 150mm cannon, the turret rotated on a circular crown of 16 cast-iron wheels. The armour was composed of a wall of rolled sheet iron topped by a spherical cap made of iron plates.

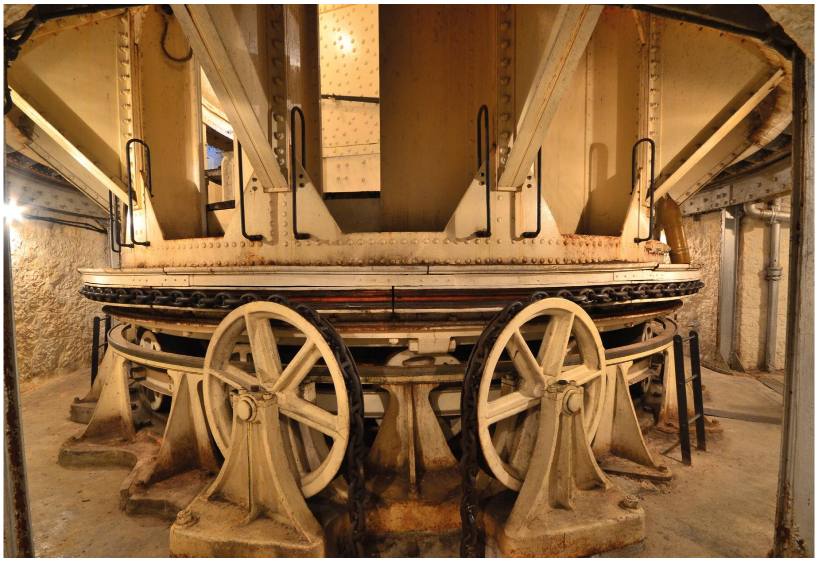
After the 1870 war between France and Germany the French created the *Commission des Cuirassements* (Armour Commission) to develop armoured protection for a system of forts being built along their redrawn Alsace/Lorraine border. The secretary of the commission was *Commandant du Génie* Henri-Philippe Mougin. He developed the *Casemate Mougin en fer laminé*, a small metal compartment fronted with rolled steel plates 15cm thick, 40cm wide and 34cm high, mounted to a concrete base.

From 1876 to 1878 the French and Germans continued to test new forms of metal. The current alloy of steel stood up well to the penetration of a shell, but shattered under repeated shock. Rolled steel was tested against cast iron. Molten iron was produced under the same conditions as steel but with a 3 per cent carbon content added. It was then poured into a thick metal mould. When it cooled it formed a very strong substance called 'chilled cast iron'. After additional testing the French armoured commission decided to use cast-iron armour rather than rolled steel sheets. Cast iron could be produced in greater thicknesses, was cheaper than rolled steel and could be moulded into more functional shapes.



The south Mougin turret of *Fort Suchet* in the Fortified Sector Alpes-Maritimes overlooks the Mediterranean Sea. The fort sits above the village of Sospel. On 23 June 1940, the guns fired on Italian troops. (Author's collection)

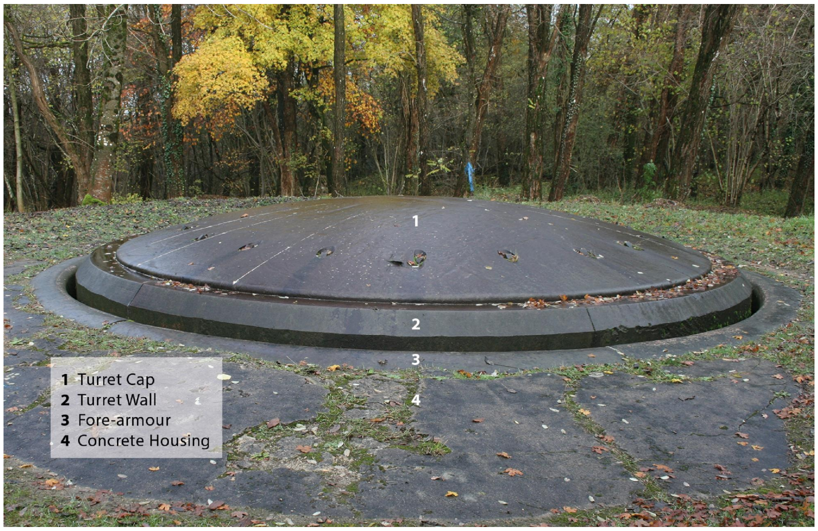
The commission proposed the development of armoured defences made of cast iron including a revolving turret that could resist siege guns. The turret would solve the problem of the limited field of fire of the armoured casemates like Mougin's earlier model. The Mougin M1876 turret prototype, developed by *Châtillon et Commentry*, was based on the designs of Schumann, Coles and Ericsson. It consisted of five moulded cast-iron wedges with a thickness of 60cm bolted together and topped by a spherical cap 20cm thick. The turret sat on a wooden platform affixed to a circular steel frame. This superstructure rotated on wheels encased in a circular track. The turret cylinder was mounted inside a concrete well and was further protected by an outer collar of cast iron called the fore-armour (*avant-cuirasse*): four iron wedges each weighing 21 tons. The turret encased two 155mm Bange M1877 cannons on Saint-Chamond gun carriages. The guns were fired using an electric trigger. The turret was rotated by an electric motor powered by a steam engine and it could also be turned by hand using a wheel in case of power loss. The maximum speed was one revolution per minute. Twenty-five of the new French forts built as part of the *Séré de Rivières* system were equipped with the Mougin turret.



Intermediate level of the Mougin *Tourelle Jeanne d'Arc* at *Fort du Barbonnet* where the operation of rotating the turret is carried out. The turret was of the *tourelle tournante* variety that was not retractable. (Vaubourg Collection – **www.fortiffsere.fr**)

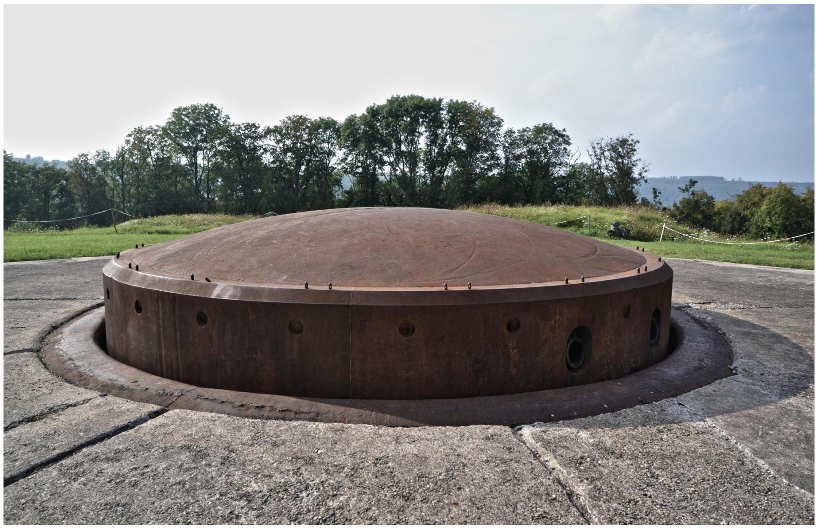
After 1878 metallurgists developed a stronger steel for industrial as well as military use, including artillery shells. This resulted in the development of a 'special' mixed-metal steel with chrome and tungsten added. Tests conducted at Buckau, Germany in October 1882 with steel projectiles found that cast-iron armour plating did not hold up well to the new steel shells. The French conducted similar tests and came to the same conclusion. In April 1884, the Saint-Chamond foundry developed a 32cm-thick plate of mixed metal and another piece made of 45cm-thick rolled steel and tested them against a 60cm cast-iron plate being used in the French turrets, firing 155mm chrome steel shells at the test plates. On the third shot the cast iron broke into pieces while the mixed-metal piece was destroyed in two shots. Eleven shots were fired against the rolled steel without causing any damage. Seven additional shots were fired on the exact same spot before the plate was finally pierced. The French had found their new armour.

Tests using a newly developed high-explosive shell containing picric acid, also known as Melinite*,* were conducted from October 1887 to May 1888 at the Camp de Châlons on two turrets, a Mougin variety built by Saint-Chamond and a second, designed by Lieutenant-Colonel Bussière built by *Compagnies de Fives-Lille et de Châtillon-Commentry*. The latter was a retractable turret that could be lowered into a concrete base to mask the embrasures. This was called a *tourelle à éclipse*, a more sophisticated variety of the *tourelle tournante* that simply revolved but did not retract to hide the gun embrasures. The walls of the Bussière turret were 45cm thick and bolted together to form a circle 4.35m in diameter. Circular plates 24cm thick were screwed into the top of the walls to form the gun compartment which rested on a cylindrical shaft attached to the floor. The cylinder was connected to a hydraulic, steam-powered piston that raised and lowered the turret. The turret was armed with two 155mm cannons equipped with hydraulic brakes to reduce recoil. While it seemed at first to consist of clever innovations, further tests on the Bussière turret found it to be too complex, too fragile, and it took too long to raise and lower. The commission preferred a simpler mechanism capable of completing the manoeuvre at a much faster speed – in five to six seconds.



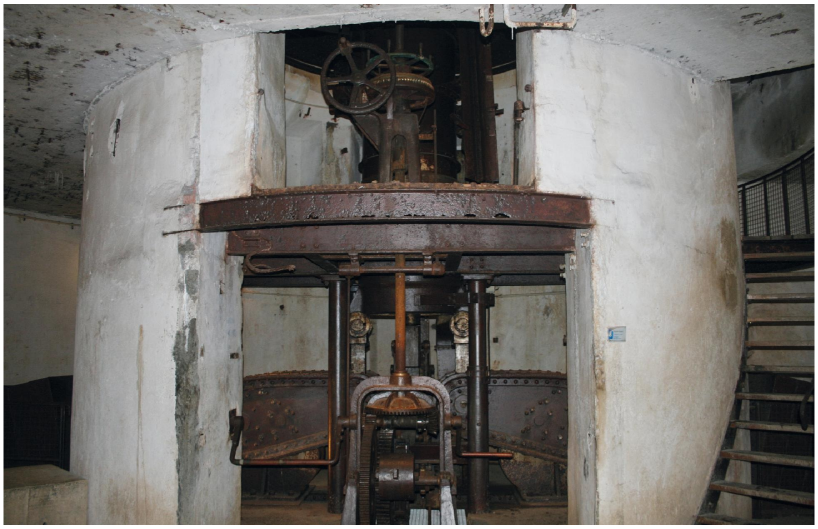
The Bussière turret – the only model of its kind installed in an annex of *Fort de Souville* at Verdun. (Author's collection)

The tests at Châlons provided all of the necessary information to develop a new type of turret. Above all the engineers needed to fulfil the requirements of the commission in relation to simplicity and rapidity of movement of the retractable system. As a result, engineers reworked the Bussière and Mougin turrets and introduced a newcomer, the Souriau model. The revamped Bussière model took on a more rounded profile, thus reducing the distance to raise and retract from 81 to 55cm. A braking system to reduce the shock produced at the apex of the vertical movements and the ability to turn the turret rapidly or slowly for a more precise aim was added to the design. However, the manoeuvre to raise the turret into the firing position still did not reach the speed requirement of the commission and the hydraulics remained too complex and delicate. The turret of Colonel Souriau was a strange design that consisted of a pivot that rested on a float in a small reservoir filled with water. The pivot was pierced at the top to allow the water to enter and this raised or lowered the turret with little effort. It took four men to work the mechanism but it also took 30 seconds to complete each action, and if the water reservoir cracked, the turret was useless. Mougin's turret was modified to protect the embrasures by moving them below the lip of the fore-armour, in a sense tipping it so that only the embrasures were hidden below the rim, rather than retracting the entire turret. This solved the speed problem but it left a large gap between the turret and the fore-armour where gas and debris could enter. These solutions were interesting but none of them satisfied the commission. The problem was solved by the introduction of a newcomer – the Galopin turret.



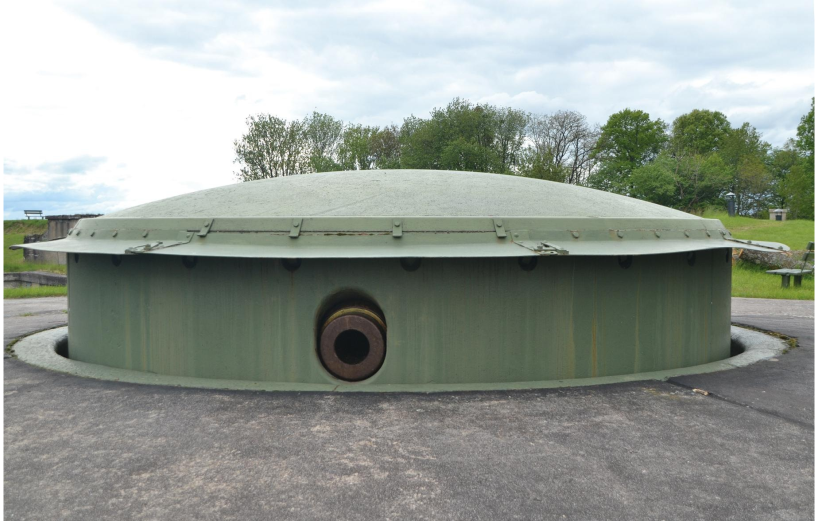
The Galopin turret for two 155mm guns. This is a restored model located at *Batterie de l'Eperon* near *Fort de Frouard*, Nancy. (Vaubourg Collection – **www.fortiffsere.fr**)

Before discussing his design, it is important to momentarily digress to the realm of physics, as it explains the attraction of the commission to Galopin's model. In order to execute the manoeuvre of swiftly raising and lowering a huge weight, such as a 200-plus-ton armoured turret, certain physical constraints had to be overcome. As well as the passive resistance (friction) of one mechanical part moving against another, a turret needed the ability to absorb the shock that occurred when the turret came to the end of its motion (battery or retraction) while still moving at a high speed. If the turret speed was not reduced when it reached the limit of its travel it would cause wear and tear on the structural components and it would crash into its frame each time it was lowered. Bussière developed a braking system to stop the turret but it did not include the means of slowing the speed of the turret as it reached its extreme positions without a resulting loss of inertia.



The Galopin turret of *Fort de Douaumont* at Verdun. Note the two beams on which were affixed the counterweights to balance the weight of the guns and turret. Note the large space required to mount the turret. (Author's collection)

In 1889, Commandant Alfred Galopin invented the first turret designed on the principle of inertial recuperation (slowing down the object while maintaining the energy needed to complete the movement of its enormous weight). The gun compartment's weight was balanced by two counterweights placed on the end of two horizontal balance beams at the base of the pivot shaft and perpendicular to the floor of the turret bloc. These beams were connected to the shaft and maintained the perfect equilibrium between the gun compartment and the counterweights. Thanks to the counterweight system, the turret's performance was amazing – it was able to complete a full manoeuvre (raise, fire and lower) in 4.5 seconds, making it impossible for the enemy to react in time to fire on the guns while it was raised. The Galopin turret not only met but exceeded the requirements of the commission and became the mechanical model for all future French turrets, including those used in the Maginot Line.



The Galopin 155R turret in the battery position at *Fort d'Uxegney* near Epinal. This is the only working model remaining. The thin sleeve around the outer edge kept the rain out of the gap between the turret wall and fore-armour. (Vaubourg Collection – **www.fortiffsere.fr**)

The Galopin turret was developed for two 155mm pieces for long-range interdiction and counter-battery fire. However, the two-gun turret was very expensive and took up a lot of space. Only five of the two-gun models were installed in the northeast. The solution to these problems was a single-gun version, the Galopin 155R. This turret possessed the same properties as the larger model but the gun was shorter (R = *raccourci*, i.e., shortened), required less of a footprint and was cheaper to manufacture.

In 1894 the French undertook the development of a turret for two 75mm quick-firing cannons and in 1901 came up with the 75R05 turret. Its function was based on the Galopin model; however it only required a single balance beam and counterweight. The mission of the 75mm turret was to provide flanking coverage of the intervals where it was not practical to install flanking casemates, such as where there were space or terrain limitations. The 75mm turret was without doubt a technical success. Its two guns fired at an astonishing rate of 20 to 22 rounds per minute. In addition, its design was robust and it was easy to manoeuvre. Testing was completed in 1905; however, the French could not afford its cost, and the programme was placed on hold. In 1916, 58 of the 75R05 turrets were installed in the post-Verdun, modernized Séré de Rivières forts. A few copies found in depots in 1930 were installed in some of the works of the Maginot Line after modifications. (See 75R05 and T2AM.)

Performance during World War I

In August 1914, Brialmont's forts of Liège and Namur, Belgium (the forts of the Meuse) were the primary proving grounds for German siege tactics. The Belgian turrets, equipped with Krupp guns, initially proved to be deadly to the invaders but the punishing German bombardment tore the concrete forts to pieces, destroying the guns and bringing about their surrender. The French border forts suffered a similar fate. In late August, the Germans marched into French Lorraine to capture Nancy and to break through the French fortress line. Their path put them on a collision course with *Fort de Manonviller*, considered the strongest fort in the French inventory.

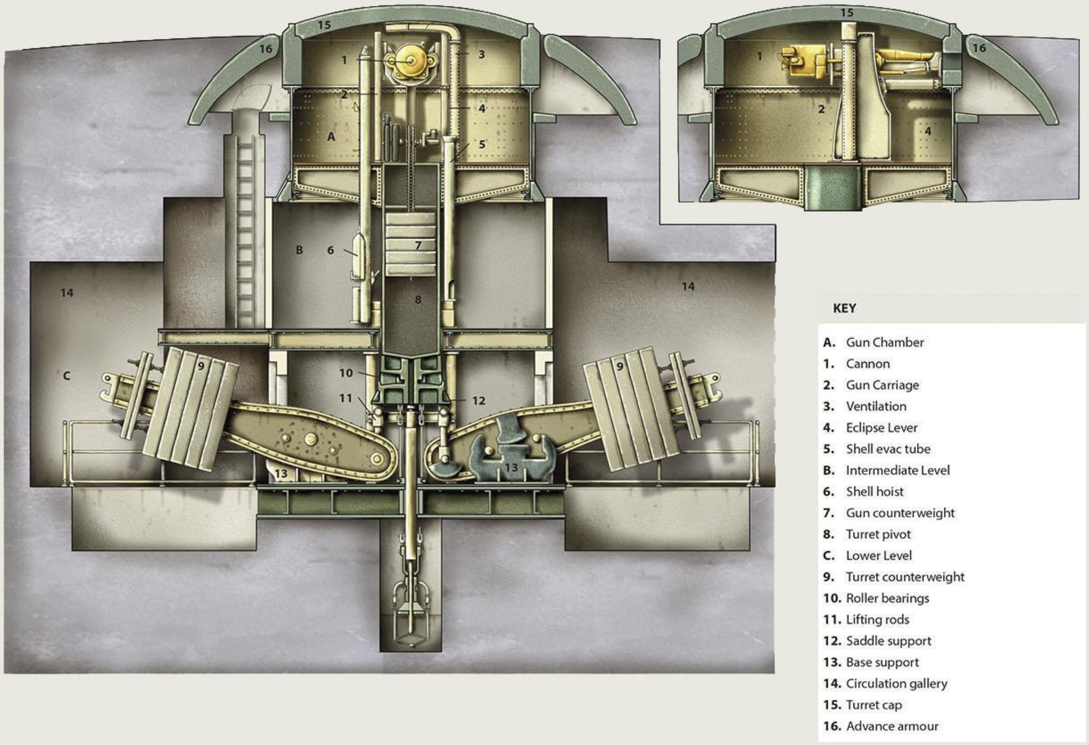
Fort de Manonviller was equipped with two first-generation cast-iron Mougin armoured turrets (two guns each) and two Galopin armoured turrets equipped with 155mm Bange cannons (also with two guns each). On 25 August, the Germans opened up their attack on the fort. A 210mm shell fell on the south Mougin turret. The explosion dislodged the fore-armour. The engineers were unable to put the plating back in position but the turret still functioned. One of the Galopin turrets was also struck and damaged. German 305mm and 420mm guns arrived on the field and bit by bit the fort was broken into pieces. At 1510hrs on 27 August the northern Mougin turret was put out of action. Only the southern Mougin turret was still partially operational except for the earlier damage to the turret housing. The rotating mechanism of the two Galopin turrets was jammed. Due to the deplorable condition of the concrete, the destruction of the guns, and smoke permeating the interior, *Fort de Manonviller* surrendered.

A piece of the 75mm turret at *Fort de Vaux*. This was broken in pieces by German heavy artillery shells in 1916. (Author's collection)

Due to the quick fall of the frontier forts, the high command took the view that permanent fortification as a reliable means of defence had lost its value. As a result, in August 1915 materiel and personnel were removed from the forts, leaving them virtually abandoned. At the outset of the battle of Verdun, Fort Douaumont, key to the main line of resistance, was easily captured on 25 February 1916 and the fort became a rallying symbol for the French from that point on. From 1 to 7 June, *Fort de Vaux* was attacked and its heroic defence became another symbol to the men still holding the line. On 23 June, *Ouvrage de Froideterre* fought off an attack with the help of its 75R05 turret. On 12 July, the stand at *Fort de Souville* (the location of the only functional Bussière turret), finally knocked the remaining wind out of the German sails.

During the entire battle of Verdun, *Fort de Moulainville*, southwest of forts Vaux and Tavannes, miraculously reoccupied and rearmed in early 1916, fired over 6,000 shells from its Galopin 155R turret and 12,000 from the 75R05, while being hit by 339 shells from 420mm guns plus 8,000 from 77mm to 305mm calibre guns. *Fort de Vacherauville* was struck by 8,000 shells ranging from 110mm to 420mm, making the fort's superstructure unrecognizable. Nevertheless, the armoured turrets, battered but repaired, supported the French attack on the Côte du Poivre on 15 December, firing nearly 900 shells. When the battle ended in French victory, Verdun's forts were reinforced by adding over 31km of bomb-proof tunnels and shelters, new entrances to the rear of the forts, electrical power stations, ventilators with poison gas filters, elevators and additional armoured gun turrets. The similarities between the concepts of 'New Verdun' in 1917 and the Maginot Line in 1931 are remarkable. The performance and symbolism of the forts of Verdun were a major factor in decisions made in the 1920s regarding France's post-war defensive system.

A GALOPIN TURRET FOR 155MM MODEL 1907



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16
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A
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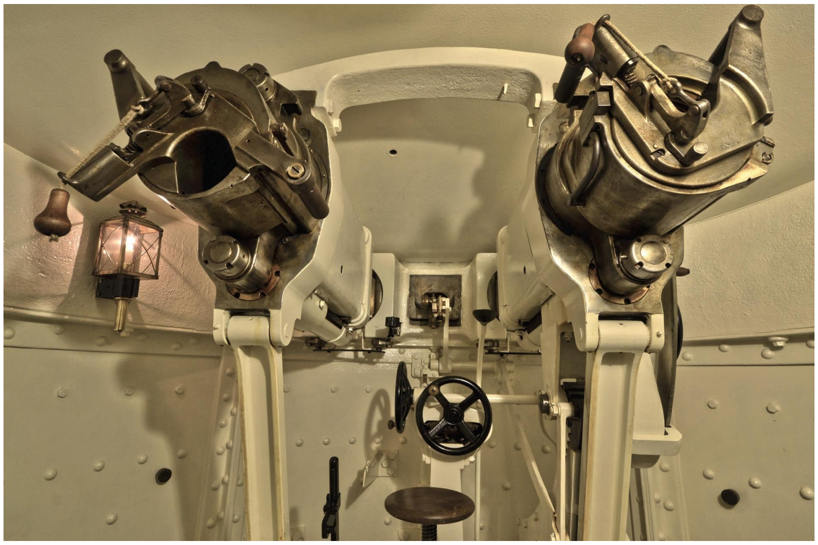
KEY
A. Gun Chamber
1. Cannon
2. Gun Carriage
3. Ventilation
4. Eclipse Lever
5. Shell evac tube
B. Intermediate Level
6. Shell hoist
7. Gun counterweight
8. Turret pivot
C. Lower Level
9. Turret counterweight
10. Roller bearings
11. Lifting rods
12. Saddle support
13. Base support
14. Circulation gallery
15. Turret cap
16. Advance armour

Originally developed in 1889 by Commandant Alfred Galopin, the turret for two 155L cannons fixed several problems associated with the retractable Bussière turret. The movement of the turret from retraction into the battery position and back took only 4.5 seconds, made possible by a very efficient double counterweight system. In 1903 the French army was looking for a less costly turret and developed a smaller turret for a single cannon with a shorter barrel, the 155R. The 155R M1907 weighed 70 tons and the gun had a range of 7,200 metres. Thirteen turrets were built and 12 installed.

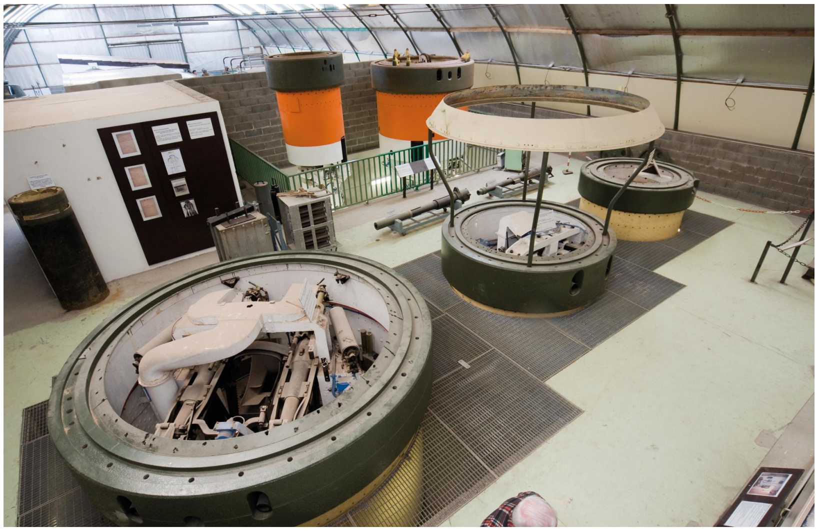
Post-War Development of the Maginot Line Artillery Turrets

In the mid-1920s the French high command appointed a new set of commissions to study the future defences of the French border in the north as well as in the Alps: the *Commission de défense du territoire* (CDT), *Commission de défense de la frontière* (CDF) and *Commission d'Organisation des Régions Fortifiées* (CORF). The CDF was the main decision maker. Composed of engineering and artillery experts, it met on multiple occasions to debate the nature of the fortifications to be built and to decide which types of artillery and infantry pieces to install in the forts.



The two 75mm guns inside the 75R05 turret at *Fort d'Uxegney*. (Vaubourg Collection – **www.fortiffsere.fr**)

The removal of 75mm guns from the flanking casemates at Verdun led to the diminished functionality of the forts. It became a policy of the CDF and later the CORF (tasked with implementing the ideas of the CDF) to create casemate and turret pieces that could not be used outside of the forts. Thus, the piece and the envelope in which it was placed were to be indivisible. This included both the gun barrel and the carriage. The new forts were designed to ensure flanking of the intervals with casemate guns; long-range, short-barrelled cannons in retractable turrets for frontal action; and heavy, medium-range mortars to hit areas hidden from direct fire. The forts would keep infantry troops and sappers at bay with mortars, machine guns and automatic rifles.



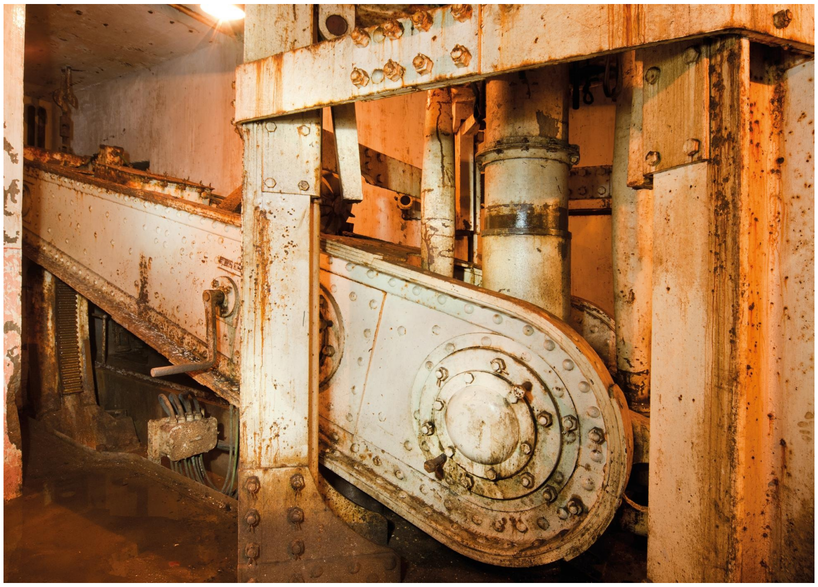
A display at the Museum of *Ouvrage du Fermont* of the various types of Maginot Line turrets. These include (clockwise from foreground) the 75/33, M1935 machine gun, 75R32; M1932 81mm and M1932 135mm. (Collection: C.J. Vermeulen)

The 75mm M1897 cannon was selected as the basic cannon-howitzer for flanking protection. A shortened version of the gun (with the barrel cut to 30cm in length) was selected for installation in the 75mm M1933 turret. It was modified to fit a new carriage, affixed with a hydraulic brake mechanism to give it a shorter recoil in the enclosed space, and a ball joint on the end of the barrel to fit snugly in the embrasure. To cover the ground that could not be reached by the longer-range cannon-howitzer, the French also developed the 75R32 gun turret, a mortar with an even shorter barrel. Finally, the 135mm M1932 *Lance-Bombe* heavy mortar had no precedent in French artillery history. The CDF proposed the concept of a bomb launcher, like a trench mortar, in a retractable turret to defend a space 3,000m to 4,000m from the approaches to the fort.

A total of 152 turrets in eight models were installed on the Maginot Line, broken down by the following numbers:

Artillery Turrets for Targets Greater than 3km	
135 M1932	17
75R32	12
75/33	21
75R05	1
Infantry Turrets for Close-In Defence	

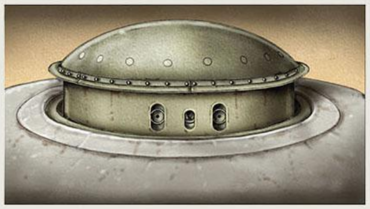
Machine gun	61
Turret for two mixed arms	12
Turret for two mixed arms plus 50mm mortar	7
81mm M1932	21

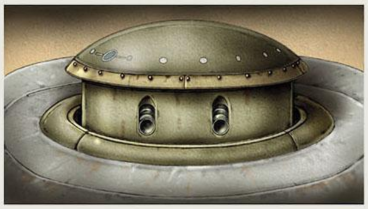


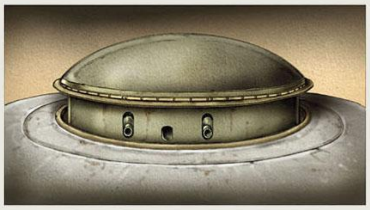
The counterbalance for the 75/33 turret. This one is located at *Ouvrage du Michelsberg*. (Collection: C.J. Vermeulen)

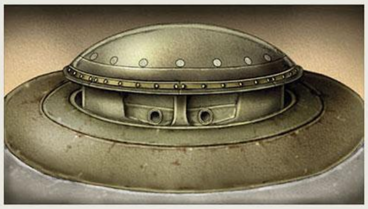
In general, the armoured turrets of the Maginot Line were built along the same principles as the earlier models. The guns were protected by a thick steel cap within steel walls. This cylinder, called the gun compartment, rested on a pivoting tube that was connected at its base to a balancing arm and a counterweight. The turret was built to function by electric power but it was equipped with a backup manual system. The shells were stored adjacent to the turret and lifted up to the gun compartment in an electrically operated lift. Spent shells dropped out of the gun breech into a chute that fed them to the lower floor of the bloc where they were recovered and re-used. Each turret was positioned in a concrete well and protected by a thick layer of reinforced concrete. The turret blocs were located on the surface and connected by staircase or elevator/staircase combination to the lower level of the underground fortress, the *ouvrage*. The turret blocs functioned efficiently with a highly trained crew to operate the guns, which were swift to fire and highly accurate.

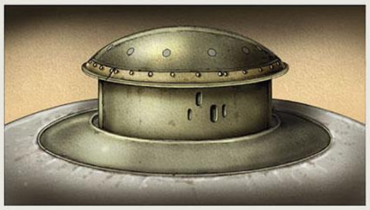
B COMPARISON OF MAGINOT LINE ARMOURED TURRETS

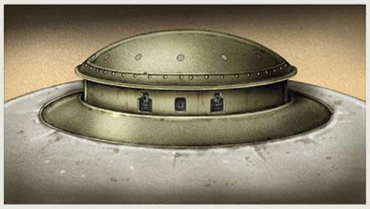

1. 75mm M1932


2. 135mm M1932


3. 75mm M1933


4. 81mm M1932


5. MAC 31 machine gun

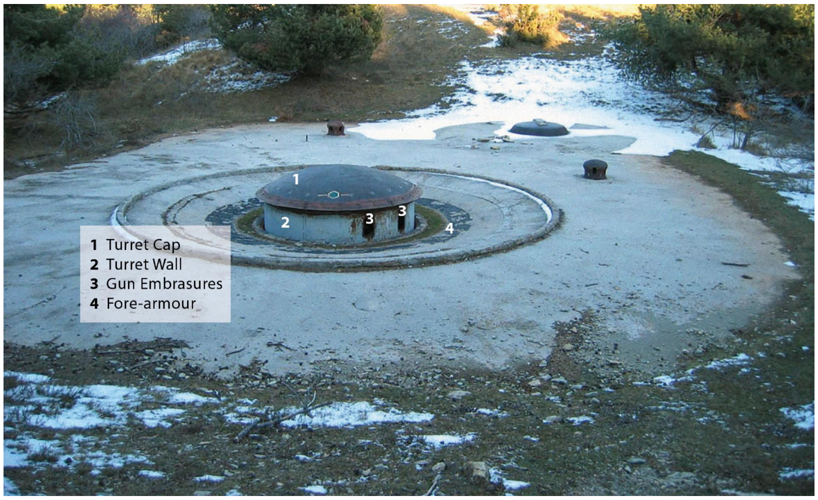

6. Mixed arms

There were six types of turrets used in the Maginot Line, in different sizes and styles. The turrets ranged from 1.98m in diameter for the machine-gun turret to 4m for the 75mm M1933 turret for two guns. The 135mm and 81mm housed curved fire mortars. The mixed-arms turret was a refurbished M1905 75mm gun turret left over from World War I.

MAGINOT LINE ARTILLERY TURRETS

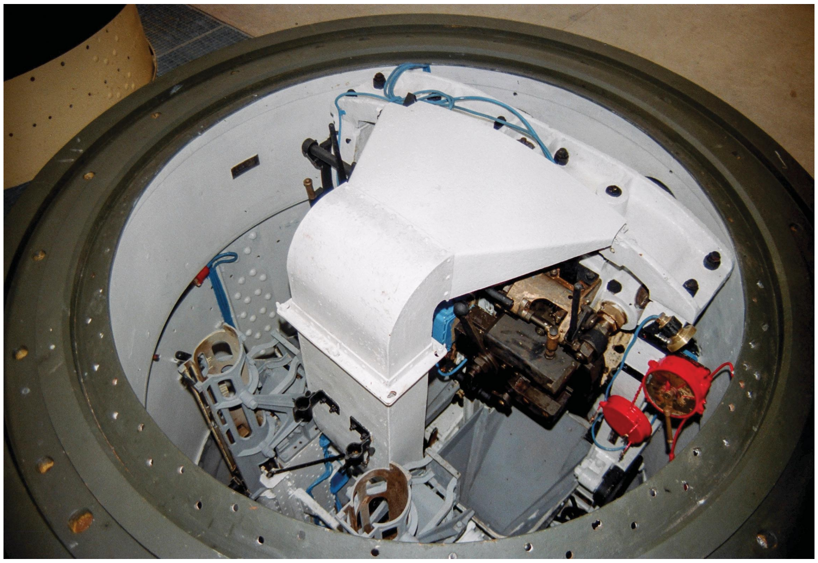
135mm Model 1932 *‘Lances-Bombes’* Heavy Mortar

The 135mm M1932 was a retractable turret armed with two 135mm mortars. The guns were identified as ‘*lances-bombes*’ by the French, which literally translates as ‘bomb launcher’. It is more akin to the German trench mortar – the *Minenwerfer* or ‘mine launcher’. The two short, stout guns were always fired as a pair, pointed in the same direction and angle of fire, like a double-barrelled shotgun. The 135mm mortar was designed for fortification use; there was no comparable field piece. It was used in both casemates and turrets to counter enemy advances towards the vicinity of the *ouvrages* where a more powerful bomb than the 81mm or 50mm mortars was needed and for targets at a greater distance of up to 4km. The barrel was short – 1.145m – and equipped with a breech that opened automatically after each round was fired.



The 135mm turret of *Ouvrage du Monte-Grosso*’s Bloc 6, in the Alpes-Maritimes. Note the indentation of the concrete pad to protect the turret from enemy fire. (Author’s collection)

The turret performed admirably during the war but it had problems and, as a result, only a small number of *lances-bombes* turrets were installed in the earlier-constructed *ouvrages*. The turret required a substantial infrastructure for a relatively small return, despite the power of the projectile. It required numerous updates over the initial period to correct wobbling of the shell during its trajectory, flashbacks (flame returns in the barrel), and weakness of the turret embrasures (this issue was never resolved). Because of its difficult start, the installation of additional pieces was abandoned in April 1934. It was to be replaced by a more reliable 105mm or 155mm gun but that did not take place.



135mm turret gun compartment. The shells were brought up from below and landed in the two baskets that were tipped over and the shell pushed into the breech. (Collection: C.J. Vermeulen)

The 135mm turret was more sophisticated than other Maginot Line turrets. The shells were very heavy (17–19kg) and could not be handled efficiently in the very small space. (See Plate C for a description of the shell loading operation.) The lift assembly was electrically operated and contributed to the increased rate of fire of 12 rounds per minute. Another reason for the high rate of fire was a unique fire control mechanism that activated the two gun triggers simultaneously.

The turret ensemble was placed under the direct orders of the commander of the bloc who acted on the orders of the artillery commander (see Operational History). The gun required a crew of 21:

- an adjutant-chief or *Adjutant, Chef de Tourelle* positioned primarily in the intermediate level who kept a record of commands and ensured that commands relayed to the bloc were carried out

- five NCOs or brigadiers who served as crew chiefs (one in the gun compartment)
- fifteen crewmen or ‘ *servants* ’ (one in the gun compartment).

The gun compartment included two crewmen.

The *Brigadier-Tireur* (crew chief):

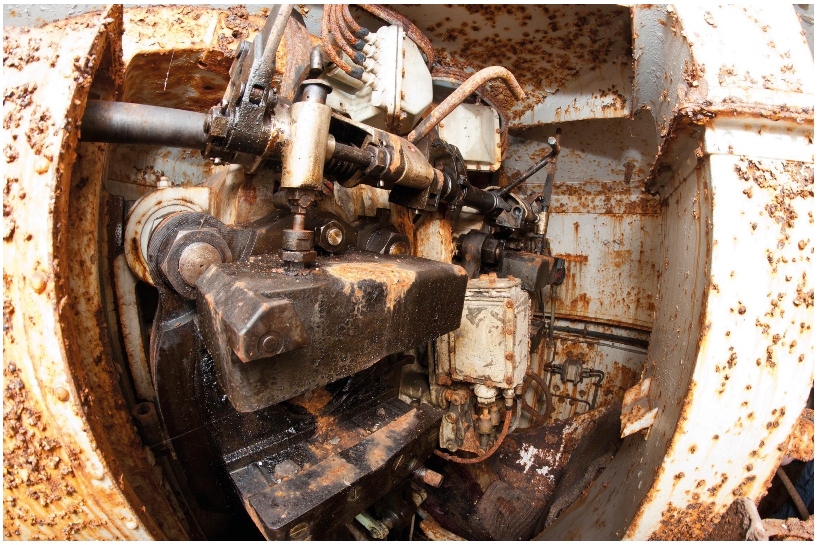
- operated the clutch to enable movement of the guns
- opened and closed the breech and loaded gun No. 1
- activated the lift cut-off switch, or in case of manual operation, a clutch pedal in the floor
- activated the right control pedal to command the electrical manoeuvring of the guns to move the turret to the right, or a wheel in the case of manual movement
- operated the trigger to fire the guns
- monitored the order transmitter (Teleflex device), or alternatively communicated with the aimer in the level below through an acoustic tube.

The *Chargeur* (loader):

- opened and closed the breech and loaded gun No. 2 (left)
- activated the left control pedal to move the turret to the left
- controlled the left shell lift
- operated the lever to enable retraction of the turret.

The right and left of the gun compartment were identified from the aspect of the gunner as he stood between the two pieces while facing the embrasures. The piece to his right was identified as the first piece (No. 1), the left was the second piece (No. 2).

Upon receiving an order to fire the guns, the crew in the lower level activated the ventilator motor. This ensured that fumes produced by the guns were removed from the gun compartment and the bloc. The ventilator was primarily operated by motor. The movement of the turret was also done by motor, and in case of an electrical system malfunction or loss of power, all operations could be performed manually. The electric motors were manufactured by *Sautter-Harlé et Cie.*



The two 135mm mortars. Both pieces were fired simultaneously. (Collection: C.J. Vermeulen)

The turret's weight required a counterbalance to equalize the weight of the turret so that its movement was smooth and quick. This was accomplished with a counterweight at the end of a balancing arm, like the 75R05 model. To avoid accidents the balancing arm was locked into place to prevent its movement. The arm was unlocked when the order was given to place the gun in battery.

135mm turret	
Diameter of the upper cap	2.90m
Thickness of the roof	30cm
Thickness of the wall	30cm
Height emerging in battery	1.05m
Total weight	163.5 tons
Maximum range	4,000m
Firing angle	45 degrees (fixed)

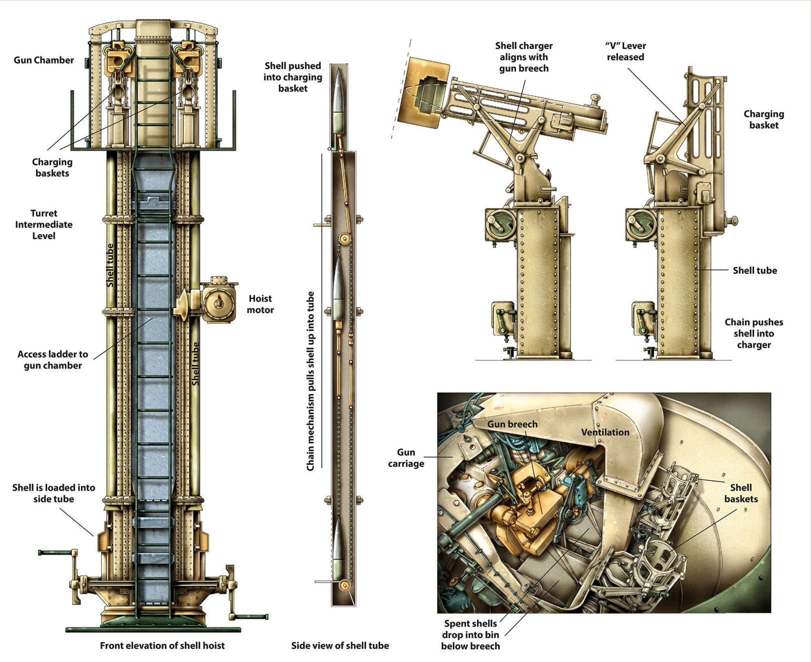
The guns fired explosive shells, M1930 or M1932. The shell casing of the M1932 was very short and could hold from zero to ten ballistic rings depending on the range of the target. The priming of the shell fuses was also adjustable to delay the explosion of the charge on impact, from instantaneous for anti-personnel targets, to a long delay for sheltered troops or vehicles.

Seventeen 135/32 turrets were installed in the Maginot Line. Two contracts were awarded, the first on 24 July 1929 *to Châtillon-Commentry et Neuves-*

Maisons for the supply of ten turrets and the second on 1 February 1932 to *Fives-Lille* for the supply of the remaining seven turrets. The first turret was delivered to Bloc 5 of *Ouvrage d’Anzeling* at the end of 1932.

C

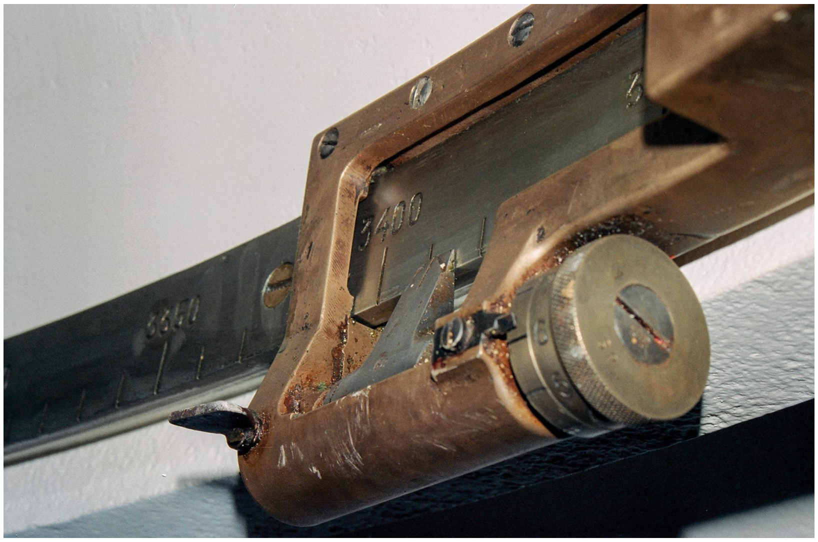
FUNCTION OF THE SHELL HOIST IN A 135MM TURRET


Gun Chamber
Charging baskets
Turret Intermediate Level
Shell tube
Shell tube
Hoist motor
Access ladder to gun chamber
Shell is loaded into side tube
Front elevation of shell hoist
Shell pushed into charging basket
Chain mechanism pulls shell up into tube
Side view of shell tube
Shell charger aligns with gun breech
"V" Lever released
Charging basket
Shell tube
Chain pushes shell into charger
Gun breech
Ventilation
Gun carriage
Shell baskets
Spent shells drop into bin below breech

The 135mm turret for *lances-bombes* presents the gunners with the problem of loading a large shell in a small space. French engineers created a unique shell hoist for the heavy mortar turret. Two delivery tubes were attached on either side of the central turret piston. The shells were loaded upright into a catch at the base of the tube. The hoist uses a ‘*Chaine Gallé*’, like a bicycle chain, to catch the shell and lift it upwards inside the tube. At the top, it was pushed into a charging basket which swivelled towards the gun breech. The shell was then pushed into the breech and the basket was pulled back to the vertical position to await the delivery of the next shell. It was very efficient in the aspect of both time and space.

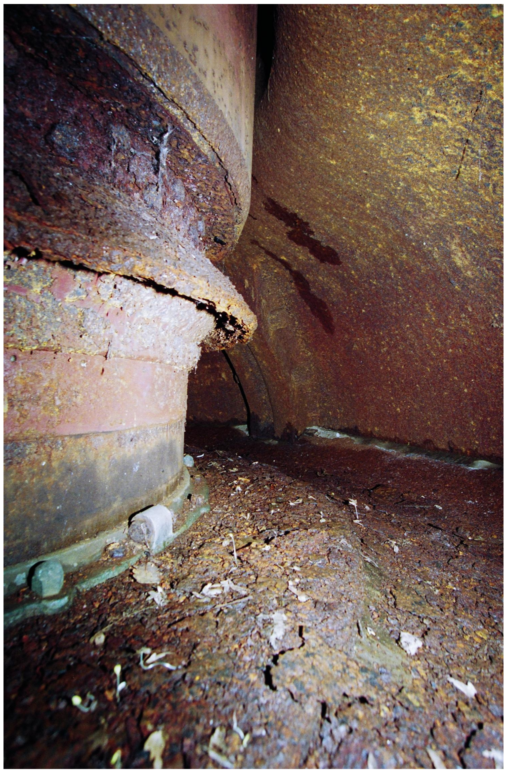
75mm Model 1933 (75/33)

The 75/33 was a retractable turret for two 75mm M1933 guns. This gun was based on the 75mm 1929 casemate model, descended from the famous 75mm M1897 field gun. The barrel was shortened to 2.421m to allow its integration into the firing chamber.



This 75/33 pointing device rode on the end of a triangular bar attached to the pivot shaft. It marked the azimuth directions for pointing and firing the guns. (Collection: C.J. Vermeulen)

The turret retained the basic retractable configuration. The fore-armour was sealed in the concrete massif of the bloc and was composed of six identical wedges in moulded steel, attached together by nuts and bolts. The steel cap of the turret rested on the thicker part of the wedge when it was retracted to form a tight seal. There was a small space between the fore-armour and the turret wall accessible by a trapdoor for performing maintenance of the gun barrels or to remove debris lodged in the space that might block the movement of the turret. This compartment also had drains for rainwater runoff.



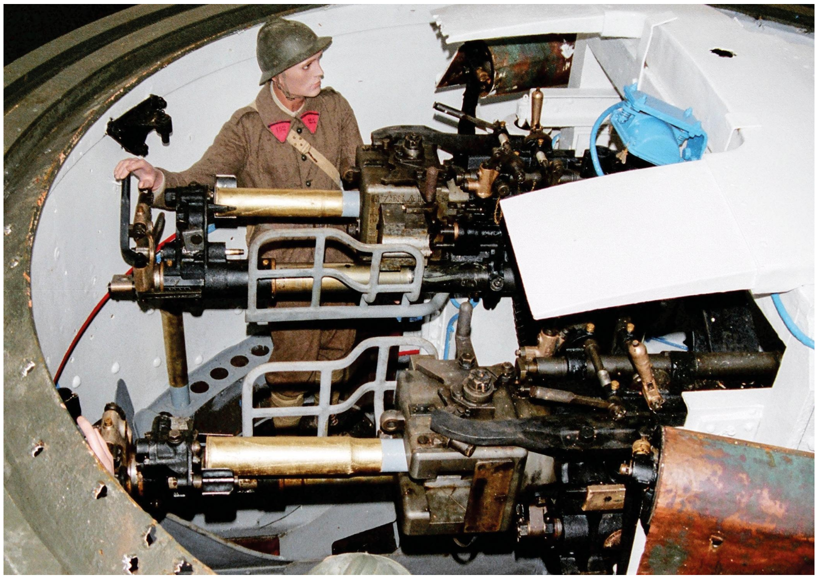
The interior of the 75/33 fore-armour compartment. The gun turret wall is on the left, the fore-armour on the right. Note the gutter running in the centre for removal of water. (Collection: C.J. Vermeulen)

The outer layer of the turret armour was composed of a roof in two layers of special forged steel in the shape of a circular skullcap and the wall in special forged steel in the shape of a cylindrical band. The roof cap sat in a tenon joint and was connected to the top of the wall by heavy screws. The wall was protected by additional layers of sheet metal screwed to the outer steel wall. The roof had three additional layers of sheet metal attached to the underside for added protection. The walls were bolted to a solid circular platform that made up the floor of the gun compartment and a trapdoor opening in the platform gave access to the compartment from below. A large metal tube (*Fût-Pivot*) was bolted perpendicularly to the underside of the gun compartment platform and ran the length of the intermediate level and part way down the lower level of the turret. The entire ensemble resembled the piston of an internal combustion engine.

The gun compartment, formed by the steel cap, the circular walls and the platform, enclosed the cannons, the gun carriage, upper turret manoeuvring position and the delivery point of the shell lifts, one on either side of each gun.

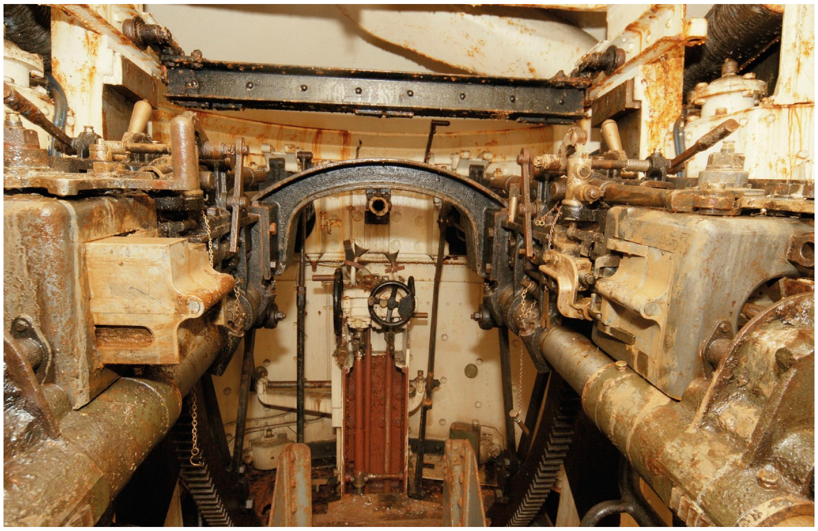
The turret was moved by a set of controls in the intermediate level of the gun turret ensemble. It could also be moved from inside the gun compartment in cases where direct fire of the guns was possible: in other words, the aimer inside the gun compartment could see the targets through a viewing scope. He could then control the movement of the turret with instruments attached to the upper aiming post between the two guns. The small-diameter opening for the viewing scope could be closed off by a mobile shutter when not in use.

The two obround embrasures for the cannon barrels were bored through the gun compartment wall and the viewing port was bored through the centre between the gun embrasures. A rounded steel collar slid over the end of the gun barrel and rested on a bronze socket in the embrasure. This acted like a ball and socket joint and allowed the gun barrels to move smoothly without exposing the inside of the turret (see the photo of the disassembled guns at the top of page 23). The two guns could be moved independently to different firing angles when raking fire was appropriate. Vertical movement of the heavy guns was aided by a counterweight that ran down the centre of the pivot shaft. The two gunners stood on an adjustable wooden floor that moved in conjunction with the level of the gun breeches to keep them in the same relative position. The gun compartment was equipped with an exhaust ventilator to draw out the gun smoke. All of the equipment was electrically operated with a manual backup in case of the loss of power; however the mechanism for the rotation of the turret was uniquely operated by hand.



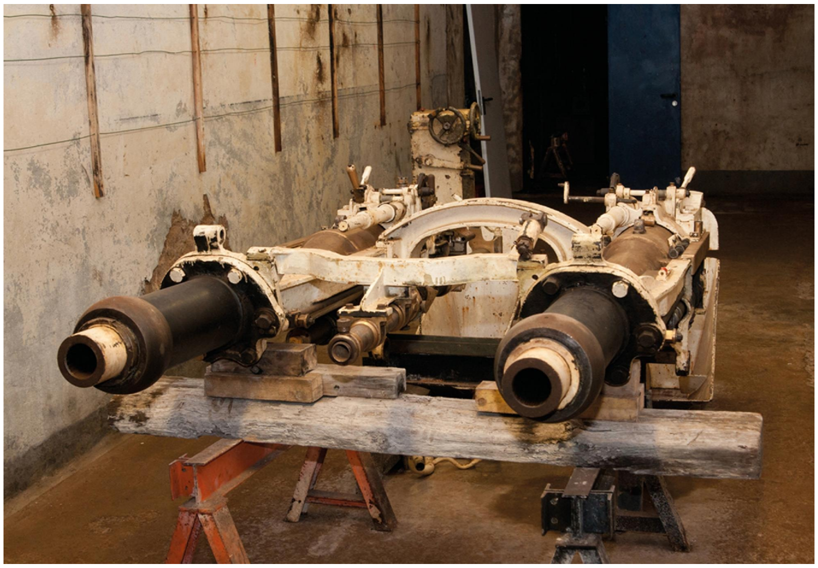
The gun compartment of the 75/33 turret at the Fermont Museum. This came from Bloc 6 of *Ouvrage du Bréhain*. (Collection: C.J. Vermeulen)

Thanks to special safety features, the guns could not be fired unless the turret was in battery, the aimer had closed the breeches after bringing them to the firing position, and the cannons were returned to their battery position. Conversely, the turret could not be retracted unless the two breeches were in their final opened position and the shells ejected.



The gun compartment of the 75/33 at Michelsberg's Bloc 5. The upper aiming post is in the centre along with the viewing port. (Collection: C.J. Vermeulen)

The exact size of the 75/33 turret crew is unknown, as there is no available documentation detailing the specifics. The 75R32 had a crew of 25; therefore since the 75/33 was larger it can be surmised that the turret had a similarly sized crew. Several documents state that there were three men in the gun compartment. Jean-Yves Mary cites records of the 151 *Regiment d'Artillerie de Position* detailing a test on 30 July 1935 in which 96 shells were fired from a 75/33 turret with a team of one officer and 16 *cannoniers*. Another source mentions a crew of 13, but the consensus among Maginot Line Association members is towards a higher figure. The answer may be available in the publication *Instruction Provisoire sur le service des pièces d'une tourelle armée de matériels de 75 modèle 33,* dated October 1935, but its location is unknown.



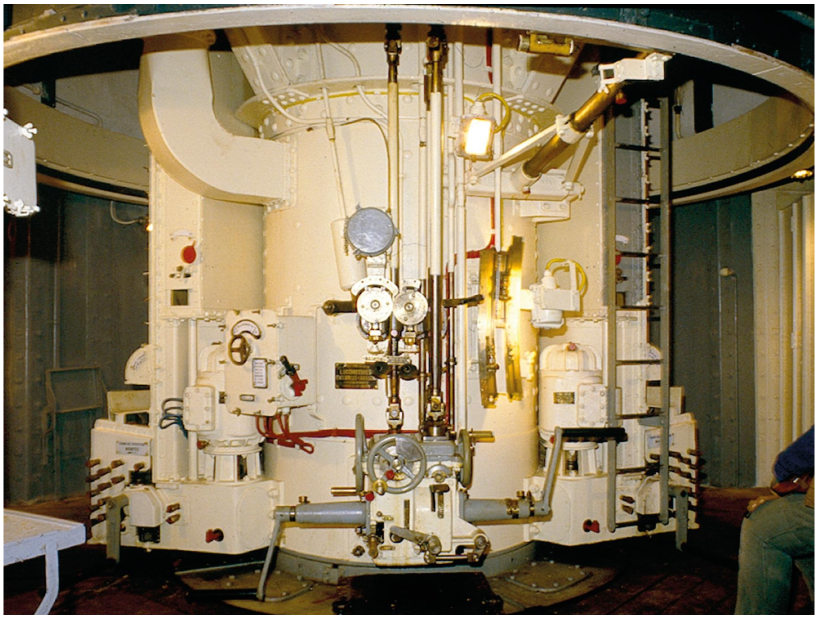
The 75mm M1933 guns on display inside *Ouvrage du Michelsberg*. (Collection: C.J. Vermeulen)

The intermediate level of the turret ensemble was below the gun compartment floor. It was a large circular room, the location of the controls to operate the turret and the two lifts to carry charged shells up to the guns. Several niches for munitions and tools were located along the walls.

The pivot shaft ran down the centre of the room and was constructed of thick sheet metal. The upper part consisted of a crown of support beams in moulded steel bolted to the bottom of the platform.

The following elements were fixed to the pivot shaft in the intermediate level:

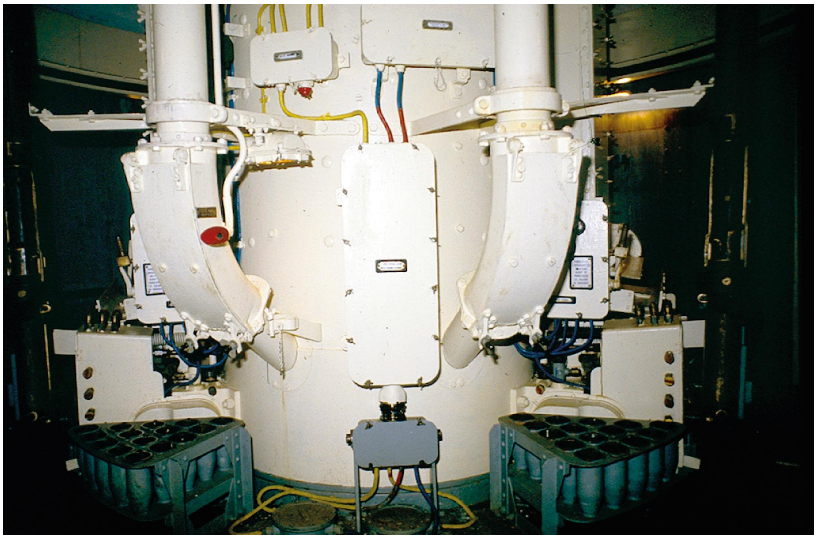
- the pointing post of the intermediate level
- the lower release lever to retract the turret
- the loading position of the shell lifts (one on each side of the shaft)
- the velocity controls for pointing in direction
- an adjustable triangular arm with an azimuth indicator on the end that pointed to the direction the guns were facing; the numbers were etched on a circular band that ran along the inside of the crown
- access ladder to the gun compartment
- ladder fixed below the trap door for changing out the gun barrels.



The beautifully restored 75/33 turret in Bloc 3 of *Ouvrage de l'Agaisen* in the Alpes-Maritimes fortified sector. The turret still possesses its original cannons on Nordenfelt carriages. The turrets were in action from 20 to 25 June 1940. (**Wikimaginot.eu** Collection)

The conduit for the evacuation of shells, exhaust ventilation, and counterweights for the guns and the mobile floor were located inside the pivot shaft. The empty shells slid down a spiral chute like a sliding board all the way to the base of the bloc.

The base of the shaft passed through the wooden floor of the intermediate level and continued to the lower level where it rested on the ball-bearing mechanism used to rotate the turret. The floor of the intermediate level was supported by steel floor joists that rested on four vertical columns. The support columns were embedded into the concrete floor of the lower level of the bloc. The balancing arm was attached to the base of the shaft. The counterweight hung from the end of the arm and moved up and down inside a square shaft in the floor.



The reverse side of the 75/33 turret pivot shaft. Note the two tubes for evacuation of spent shells from the two guns above. (**Wikimaginot.eu** Collection)

75mm Model 1933 turret	
Diameter of the upper cap	4.0m
Thickness of the roof	35cm
Thickness of the wall	30cm
Height emerging in battery	1.26m
Total weight	265 tons
Maximum range of the guns	11,900m
Rate of fire per piece	13 rounds/min
Angle of fire	-2 degrees to + 40 degrees

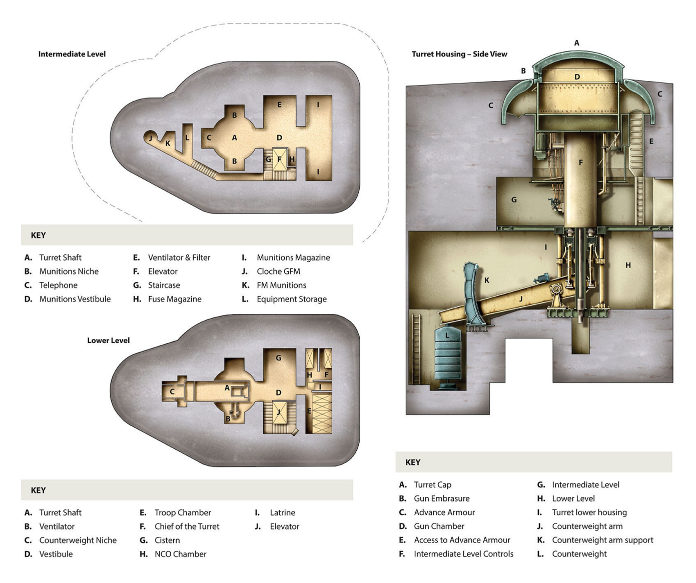
Each piece was allotted 6,400 shells in several varieties as follows:

Explosive shells including M1900 of 5.25kg, M1915 of 5.16kg, M1917 of 6.20kg with percussion rocket, Model FA 1929 of 6.96kg with impacting rocket	4,480
Ballistic shells (M1926 of 7.24kg)	1,600
Armour-piercing shells (Model M of 6.40kg with base rocket)	192
Shrapnel shells (M1913 of 7.25kg), for infantry targets within range of less than 300m	128

Twenty-one 75/33 turrets were installed in the Maginot Line, numbered 201 to 221. They were manufactured by *Châtillon-Commentry et Neuves-Maisons* (six turrets), *Batignolles-Châtillon* (eleven), and *Chantiers de la Loire* (four). The cost of each turret and its guns, including transportation and installation, was around 4.5 million francs.

D

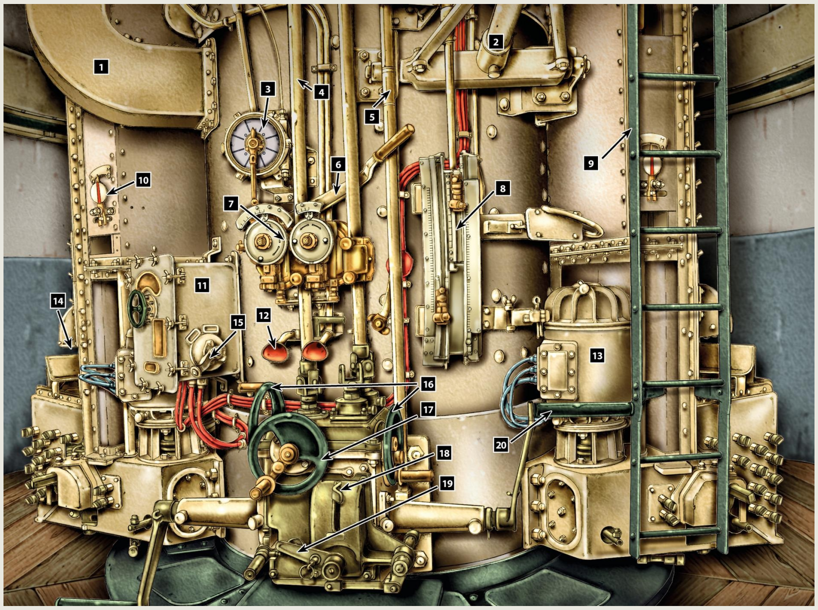
75MM MODEL 1933 TURRET BLOC


Intermediate Level
A
B
C
D
E
F
G
H
I
J
K
L
KEY
A. Turret Shaft
B. Munitions Niche
C. Telephone
D. Munitions Vestibule
E. Ventilator & Filter
F. Elevator
G. Staircase
H. Fuse Magazine
I. Munitions Magazine
J. Cloche GFM
K. FM Munitions
L. Equipment Storage
Lower Level
KEY
A. Turret Shaft
B. Ventilator
C. Counterweight Niche
D. Vestibule
E. Troop Chamber
F. Chief of the Turret
G. Cistern
H. NCO Chamber
I. Latrine
J. Elevator
Turret Housing – Side View
KEY
A. Turret Cap
B. Gun Embrasure
C. Advance Armour
D. Gun Chamber
E. Access to Advance Armour
F. Intermediate Level Controls
G. Intermediate Level
H. Lower Level
I. Turret lower housing
J. Counterweight arm
K. Counterweight arm support
L. Counterweight

Plan and side elevation of a 75mm M1933 turret bloc. The base plan on the left is from Bloc 4 of *Ouvrage du Michelsberg*. The 75/33 turret structure was housed on three levels. The lower level with access to the elevator and staircase to the underground, contained the support and counterweight to lift the entire turret housing into the battery position. The gun commander was situated in the intermediate level. From this location, the crew received the firing commands from the artillery commander. The controls to turn and raise/lower the turret were located at this level (see plate E). Munitions were also stored here and were lifted to the top level, the gun chamber. This was a small metal container that housed the two 75mm guns.

E

75MM MODEL 1933 TURRET CONTROLS



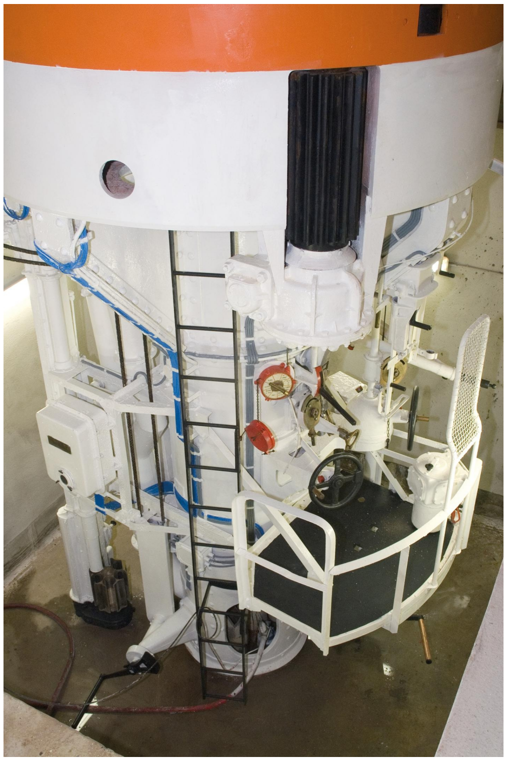
This plate shows the main controls used to turn and raise/lower the 75mm M1933 turret. This is the intermediate level of the turret housing.

Key

1. Ventilator shaft from gun chamber
2. Directional indicator arm (telescopic)
3. Axiometer – communicate orders
4. Control shaft – directional
5. Control shaft – height
6. Control lever – raise/lower turret
7. Directional indicators (L – direction; R – height)
8. Height indicator
9. Access ladder to gun chamber
10. Lift control (A – *Arret*; M – *Marche*)
11. Rheostat start-up box for shell hoist

12. Acoustic tubes
13. Motor for shell hoist (each side)
14. Shell hoist (left and right side)
15. Interruptor switch for shell hoist
16. Wheel for slow speed (height/directional)
17. Wheel for rapid speed
18. Speed adjustment clutch
19. Security lever
20. Hand crank for rapid manoeuvre

75mm Model 1932 R (75R32)



75R32 turret at Fermont Museum. The aiming post is on the platform part way up the side of the pivot shaft. The Teleflex device dial is ringed in an orange frame. (Collection: C.J. Vermeulen)

This turret was smaller in scale than the 75/33 and allowed the gunners to strike zones not covered by mortars but with a more extended range. The 75R32 turret was equipped with two 75mm cannons similar to the casemate model with a firing angle of -5 degrees to +35 degrees. The two pieces were independent and were perfect for raking fire to increase the area covered when using ball or shrapnel shells. The maximum range of the guns was 9,600m, and the nominal firing rate 26 rounds per minute, which was able to exceed 50 shots per minute for very short periods of time, limited by ammunition supply and overheating of the barrels. They were cooled as needed by spraying them with water. Some turrets were equipped in their fore-armour with a system of nozzles that allowed water to be injected directly into the mouths of the barrels when the turret was retracted. The turret had a crew of 25.

75mm Model 1932 R turret	

Diameter of the upper cap	3.04m
Thickness of the roof	30cm
Thickness of the wall	30cm
Height emerging in battery	1.02m
Total weight	188.7 tons

The type of shell was chosen according to the objective:

Model	Range at 45 degrees	Range at 25 degrees	Muzzle velocity
Explosive shells			
M1917	9,600m	8,300m	487m/sec
M1900-1915 (full load)	7,700m	6,500m	462m/sec
M1900-1915 (average load)	6,100m	Not known	353m/sec
M1900-1915 (reduced load)	5,400m	4,900m	303m/sec
Other shell types			
Bullet shell M1926 (used in defence against aircraft or personnel)	–	–	453 m/sec
Rifle shell (used against armour)	8,100m	6,900m	480 m/sec
Shrapnel (used in close defence against personnel)	–	–	535 m/sec

Twelve 75R32 turrets were installed on the Maginot Line, numbered 401 to 412. They were manufactured by *Cail* (four turrets), *Châtillon-Commentry et Neuves-Maisons* (five) and *Ateliers et Chantiers de la Loire* in its factory at Saint Nazaire (three). The fore-armour for these turrets was produced by the *Forges et Aciéries de St-Chamond, Aciéries de Longwy* and *Schneider* at Creusot. The cost of the turret was about 2.5 million francs.

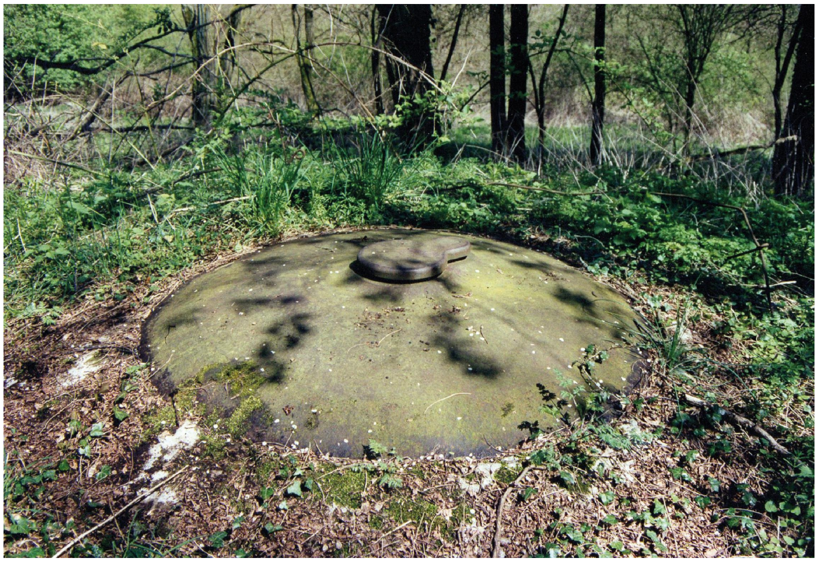
75mm R Model 1905 (75R05)

The 75R05 turret was designed for two 75mm R M1905 cannons (with a shortened barrel). Although originally built for the Séré de Rivières forts in the early 1900s (as mentioned on page 10), the 75R05 is discussed here again because, to save costs, the CORF recommended its re-use. Twelve of the former 75R05 turrets were refurbished and converted to mixed-arms (T2AM) turrets (see page 34). The thirteenth turret with its original armament was installed in Bloc 5 of *Ouvrage du Chesnois* in the Fortified Sector of Montmédy. Its modernization by *Châtillon-Commentry* included reinforcement of the fore-armour, and upgraded parts and auxiliary systems (transmission of orders, ventilation, lighting, supply of ammunition, etc.). The turret operation remained manual; no motorization was planned. The conversion to the mixed-arms model will be discussed later.

The choice to re-use this obsolete turret for reasons of economy had its consequences in May 1940. Its short range (8,200m) did not allow *Chesnois* to effectively intervene to defend *Ouvrage de La Ferté* while it was under attack by German pioneers. The turret was sabotaged by the crew before its departure in mid-May and it was eventually scrapped by the Germans.

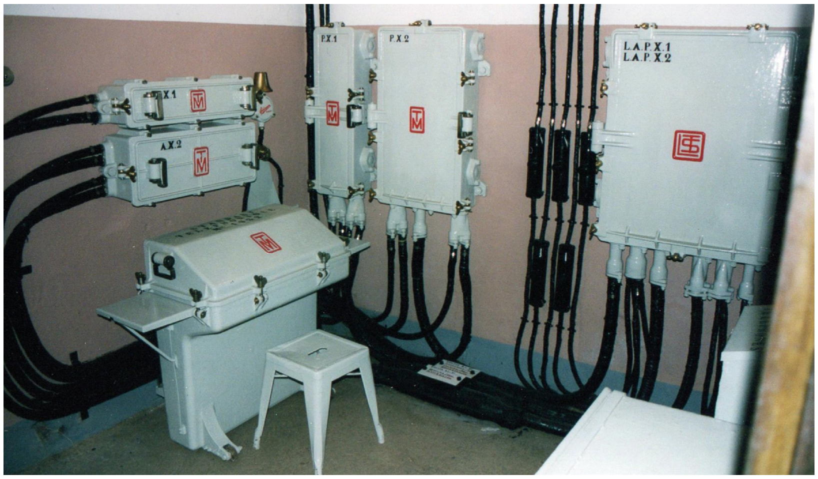
ARTILLERY FIRE CONTROL AND FIRING METHODS

The Maginot Line Command and Control process, a combination of observation, communication and armaments, allowed the *ouvrages* to perform their missions timely, quickly and with high precision.



A periscope cloche. (Author's collection)

It was indispensable for the commander, and the ability of the *ouvrage* to fire effectively, to be able to keep close watch on, from as far away as possible, the terrain on which the enemy would pass. The observer must be able to search the ravines, the edges of the woods and in the villages, and when the enemy was spotted, to carefully follow his movements, detect his intentions and prepare a rapid reply. Only observation that was reliable and precise could obtain these results. That is why the Maginot Line was provided with numerous observatories that furnished information to the commanders and provided the required location information, verification of objectives and fire control assistance.



The telephone exchange inside the *Abri de Bockange* in Boulay Fortified Sector. 'TM' stands for *Téléphone Militaire*. (Author's collection)

Observatories were located in places that provided the best views of the terrain. There were two main types: those attached to an *ouvrage* or contained within a casemate bloc and isolated, solitary blocs.

The crew of the isolated observatory, which we will examine here in detail, was made up of an officer who was posted in the observation cloche (*cloche de surveillance)* and an NCO in a periscope cloche within the same bloc *(cloche periscopique)*. The officer-observer watched through a special set of binoculars affixed to the embrasure of the cloche. The NCO was equipped with a very precise periscope, able to give a more exact measurement of the bearing and range of the target. The shaft of the periscope, 5cm in diameter, protruded 10cm from a slot in the top of the cloche. The opening could be closed off with a small flap. The two cloches were a certain distance apart but they were connected by an acoustic tube through which the two men could talk to or overhear each other. They also had access to the interior of their bloc by a ladder.

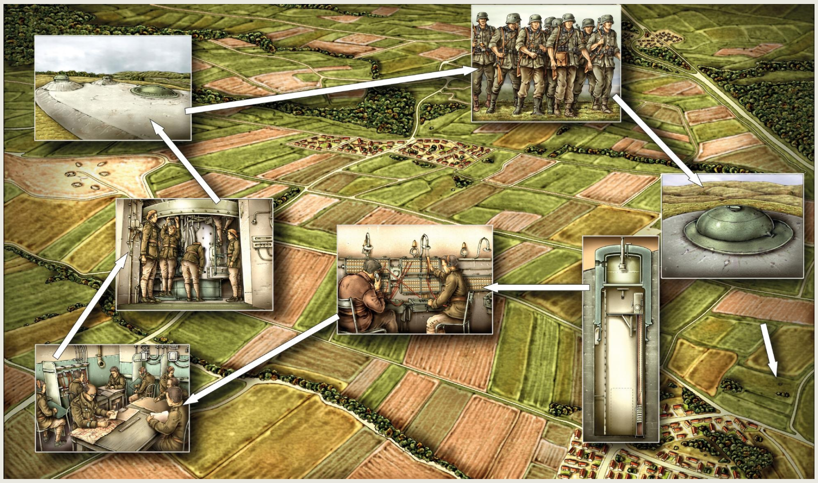
The observation process was as follows:

- Object was spotted by the officer in the surveillance cloche.
- He gave a rough bearing and range by telephone to the artillery command post *Poste de Commandement d'Artillerie* (PCA). If necessary he could refer to a set of panoramic photos of the surrounding terrain marked with the identification coordinates of certain targets and locations (buildings, hills, woods, crossroads, etc.).

- The NCO in the adjoining cloche overheard the officer's conversation, looked through his periscope, acknowledged the objective, determined the exact bearing and range, and provided the coordinates to the PCA.

Command and control inside an artillery *ouvrage* was organized as follows:

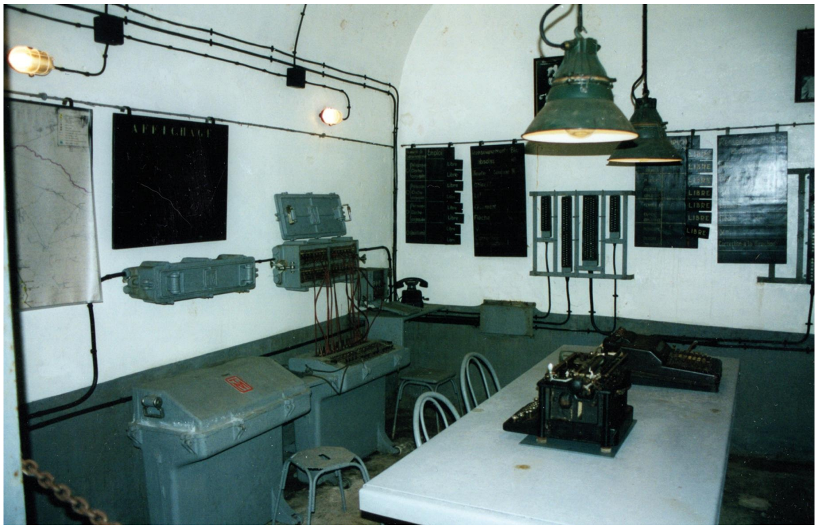
F MAGINOT LINE FIRE CONTROL



Fire control in the Maginot Line was very efficient and accurate. It was a combination of observation, swift communication between observers, command and gunners, accurate guns and fire correction. It took only a couple of minutes from the time the enemy was observed until shells were fired. Observers were constantly on watch by direct vision or periscope, looking out over the surrounding terrain. This example shows the relationship between the Hoffen Observatory and Bloc 4 of *Ouvrage du Schoenenbourg* in SF Haguenau. Observers spotted the enemy (**1**), plotted the location inside their observatory (**2**), called the telephone switchboard inside the adjacent fort (**3**) who contacted the artillery commander (**4**). The target was once again plotted and the commander decided which guns would be used on the target by, in this case, Bloc 4 (**5**). The crew was alerted, shells loaded (**6**) and fired on target (**7**). Observers reported necessary corrections and the process was repeated.

Command Post (*Poste de Commandement* – PC) of the *Commandant de l'Ouvrage*

Location of the Fortress Information Service – *Service de Renseignments de l'Ouvrage* (SRO) – where all information was received and recorded. The commander maintained a logbook of all activity that took place in the *ouvrage*. He was not directly involved in the decisions made in the PCA but he knew what was going on at all times.



The infantry PC of *Ouvrage du Schoenenbourg*. Works on the same principle as the PCA.
(Author's collection)

Artillery Commander Post (PCA)

The PCA was a rectangular room located in the lower part of the fort adjacent to the PC of the commandant and in proximity of the combat blocs. It was broken into two sections described below:

SRA – *Service de Renseignments d'Artillerie*

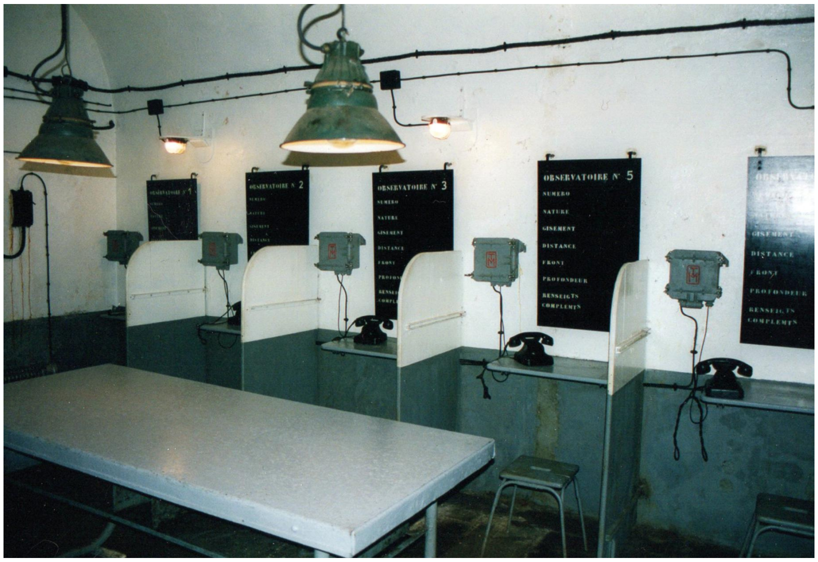
Two secretaries with two NCO assistants sat at a large metal table and the SRA officer stood behind them. Along the wall in the direction they were facing were carrels where telephone operators maintained direct contact with the artillery observatories (each observatory was numbered using the designation 'O'). The operators were seated and each had a chalkboard on the wall in front of them. When a target was spotted by an observatory, the operator received a call from his assigned observatory and wrote the information on the chalkboard.

The NCO at the metal SRA table referred to informational documents on each observatory. He validated the information annotated by the operator and marked on another board the message number and the time it was received. A secretary copied the message in a notebook record, then the SRA officer reviewed the message and verified it was correct.

PCT – *Post Centrale de Tir*

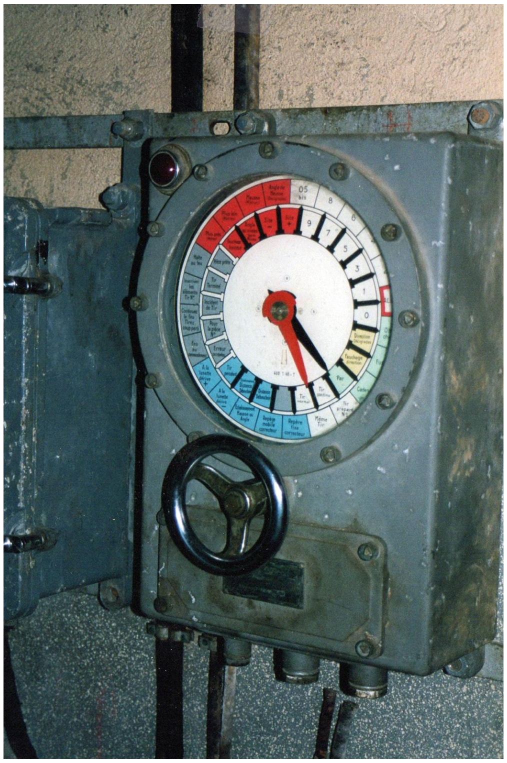
The order was then carried over to the *Commandant d'Artillerie* who was in the same room and positioned to the left of the SRA. This section of the room was called the Central Firing Post; the artillery commander had seen what was taking place and was already making the decision about which gun(s) to use on the target. He then selected the appropriate bloc to be used to respond to the threat and wrote the bloc number on the board. This information was transcribed by a secretary (clerk).

Artillery bloc PC



The artillery commander post of *Ouvrage du Schoenenbourg*. The operators sat in the carrels and were connected to an observatory. (Author's collection)

Each bloc had a command post located at the base of the bloc. The PC of the selected bloc was linked to the observatory's periscope cloche and annotated the information about the objective. A telephone operator in the PC of the bloc inscribed the message information on a blackboard and the team of the PC entered into action. The suggested order to be given to the gun turret was determined and the order was inscribed on a board labelled 'Orders'. The target plotter determined if any adjustments in direction needed to be made based on changes in wind speed or temperature. The bloc commander verified the decisions made by his staff and gave the official orders (type of fire, priming, type of shells to use). These instructions were passed on to the turret via the *Carpentier* order transmitter (see next page). The command of 'Alert' was given by the bloc commander and the crew of the turret ran to their posts.



A *Carpentier*-type transmitter in a bloc PC of *Ouvrage du Galgenberg.* (Author's collection)

An order transmission device was used when the noise inside the combat bloc made it difficult to hear commands. The main transmitter used in the Maginot Line was developed by *Société Carpentier*. The device came in pairs: one transmission device was installed in the bloc command post; a second device in the intermediate level of the turret. Each device had a circular dial with identical indicators and a double needle adjustable by a knob at the base of the transmitter that was synchronized with the second machine – the receiver. The operator in the PC placed the black master needle of the transmitter on the selected order. This in turn moved a red needle in the receiver box to the prescribed order. The operator then pressed a button that lit up a red light on the transmitter. A red light also lit up on the receiver in the bloc and an alarm bell sounded indicating there was an order. The operator of the receiver box turned his black needle in alignment with the red needle indicator, then pressed the activator button on the receptor which shut off the red lights in both boxes and indicated to the PC that the order was received and acknowledged.

A second type of transmitter, the *Transmetteur d'ordres Téleflex,* was a mechanical device used within the combat bloc to pass orders from the *Chef de Tourelle* in the intermediate level to the gunners. The device was composed of two cylindrical bronze dials with identical indications on the front, one at the intermediate level, the other in the gun compartment. A handle connected to a steel cable was linked to another handle in the second device that moved the indicators to the same position.

The artillery turrets fired a number of different packages: raking fire, where the two guns fired in unison and their angle and direction was adjusted to rake the target area; in salvoes of a certain number; normal fire directed along a certain specified zone, measured in depth and front; and concentrated fire with rounds fired by a minimum of three blocs.

The artillery bloc sequence of fire was as follows:

- Electric motors were switched on
- The ventilation system kicked on
- Airtight doors in the base of the bloc were closed and the interior pressure of the bloc was raised to force smoke exhaust to the outside
- The coordinates were marked by the pointer and assistant pointer
- The heavy turret mass shook, raised and turned the guns towards their objective
- The shell hoists were activated and the fuses were adjusted and attached to the shells which were placed into the lifts to be pulled up to the gun compartment
- Inside the gun compartment the breeches were opened and the barrels moved to the designated angle of fire
- The shells arrived at the top of the lift, were seized by the loaders and slid into the breeches which slammed shut
- The triggers were engaged and the shells fired
- The message ' *coup parti* ' (shot underway) was given

- The breeches opened automatically and ejected the shells into a funnel that led down to the base of the bloc 30m below
- The process ended with the order to ‘ *terminé* ’ (terminate).

From spotting of the target to *coup parti* took about three minutes.

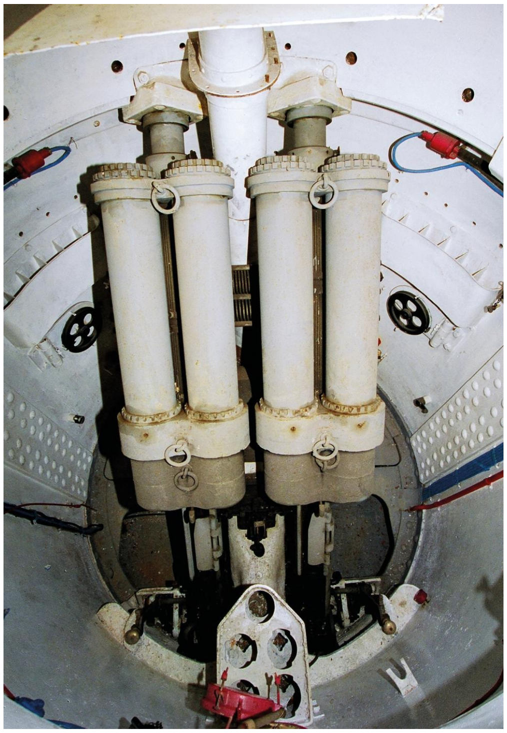
After firing the prescribed package, observers communicated the results to the artillery commander who ordered necessary corrections or reported positive results to the commander of the *ouvrage*. The observers were knowledgeable enough to know which piece was firing on which target.

MAGINOT LINE INFANTRY TURRETS

81mm Model 1932 Mortar

The mission of the 81mm turret was to ensure the close defence of the fort, to provide interlocking fire with adjacent casemates and fire support for interval troops. Due to its reduced power, the 81mm turret was the ideal weapon for scouring the tops of adjacent blocs without damaging the bloc itself. Like the 135mm mortar, the 81mm was housed in a recessed position on top of the bloc like a bowl, making it difficult to hit when in the battery position.

81mm Model 1932 Mortar turret	
Diameter of the upper cap	2.35m
Thickness of the roof	30cm
Thickness of the wall	30cm
Height emerging in battery	60.8cm
Total weight	124.6 tons
Maximum range of the guns	3,600m
Rate of fire per piece	26 rounds/min
Angle of fire	45 degrees

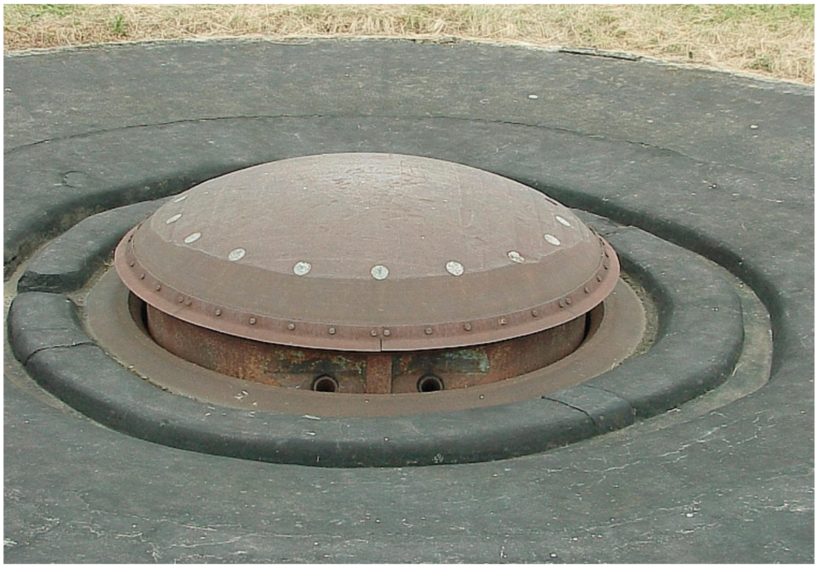


Two 81mm 1932 mortars inside a turret on display at Fermont Museum. (Collection: C.J. Vermeulen)

The turret was equipped with two 81mm M1932 mortars. The guns had identical characteristics to those of the casemate model with the exception that the casemate had a firing angle of 45 degrees while the turret covered 360 degrees. The guns were set at a fixed angle of 45 degrees. Range was adjusted by regulating the gas pressure expended by the firing of the shell. The force of the blast was transferred to two large cylinders attached to the top of the mortars. The more space inside the cylinders the less force and the shorter distance the shell travelled. The cylinder volume was manually adjusted with a wheel located on the left side of the gun. The two mortars in the turret could be adjusted independently. The mortar ammunition was in one piece, therefore there was no need to collect spent casings. As a result, the turret design was simpler than the artillery models and it was easier to operate. The movement of the turret and the shell hoists were powered by electric motor. The 81mm mortar turret required a crew of 21 men, consisting of six NCOs and 15 crewmen.

A total of 23 81mm mortar turrets were installed; numbered from 301 to 323. They were manufactured by both *Batignolles*, and *Châtillon-Commentry* at a cost of about two million francs. Twenty-one out of 23 were installed in the northeast (turret numbers 301 to 321). Turrets 322 and 323 were not installed.

One of these was planned for installation in the Alps at *Ouvrage du Plan-Caval* but the fort was never finished. It was recovered after the war and re-installed at *Ouvrage du Four-à-Chaux* to replace turret 314 that was destroyed in 1940. There are no details available on the second uninstalled turret.

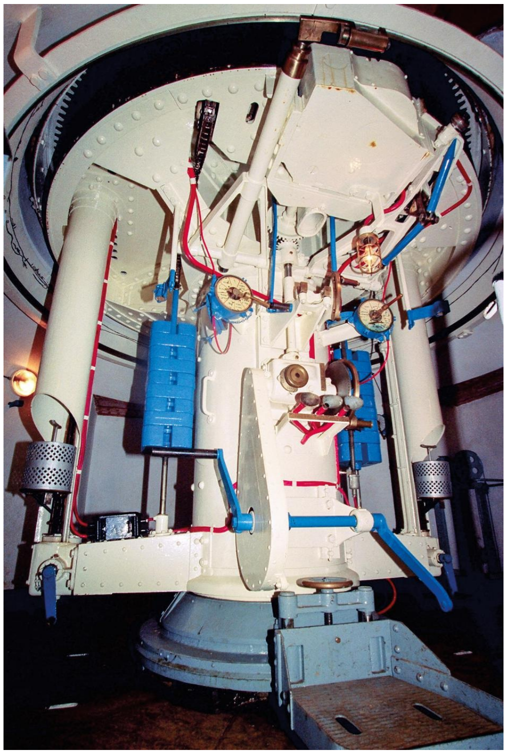


81mm turret in battery. Note the indentation similar to the 135mm turret. (Author's collection)

Model 75R05 for Two Mixed Arms (T2AM)

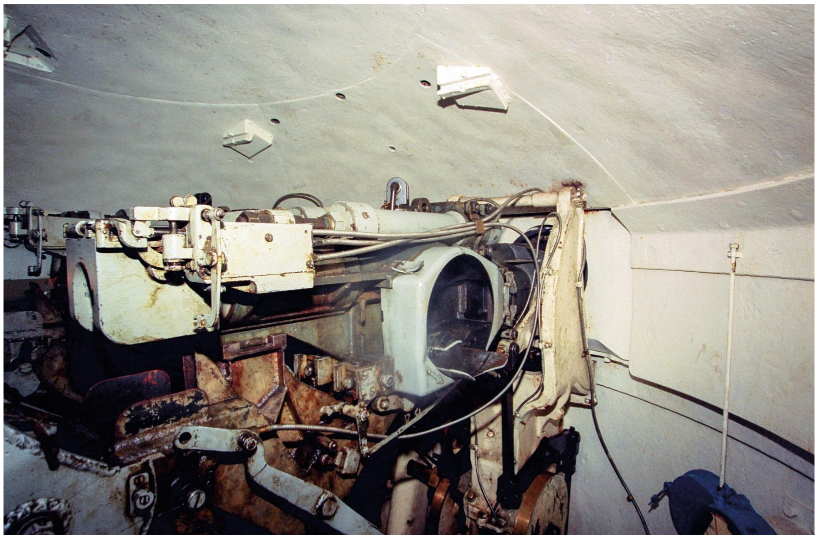
The turret for two mixed-weapon types was a recycled 75mm R M1905 (see Artillery section). The turrets were modified beginning in 1934 by the *Société d'Ateliers et Chantiers de la Loire*. The mixed-arms turret was installed from 1936 onwards.

The turret was equipped with two weapon combinations each composed of two Reibel MAC 31 machine guns plus a 25mm model 1934 anti-tank gun with a tube shortened to 1.5m to fit the dimensions of the turret. The 25cm anti-tank gun was mounted on top of the paired machine guns. The triplex pieces were self-contained and each had its own pointing device and L700 viewing scope. The gunner sat and controlled the guns from a seat directly under the gun assembly. They were cooled by spraying water on the barrels using a Vermorel sprayer, a brass container with a hose attached.



A fully restored turret for two mixed arms at *Ouvrage de Rohrbach*. The shell hoists are located on the outside, the gun counterweights next to the shaft with two Teleflex devices above. (Collection: C.J. Vermeulen)

Communication between the pointer and the intermediate level was through an acoustic tube. A Teleflex transmitter was used when there was too much noise. Commands between the bloc PC and the turret were transmitted by a *Carpentier* Model 1937 transmitter (see Operational History).

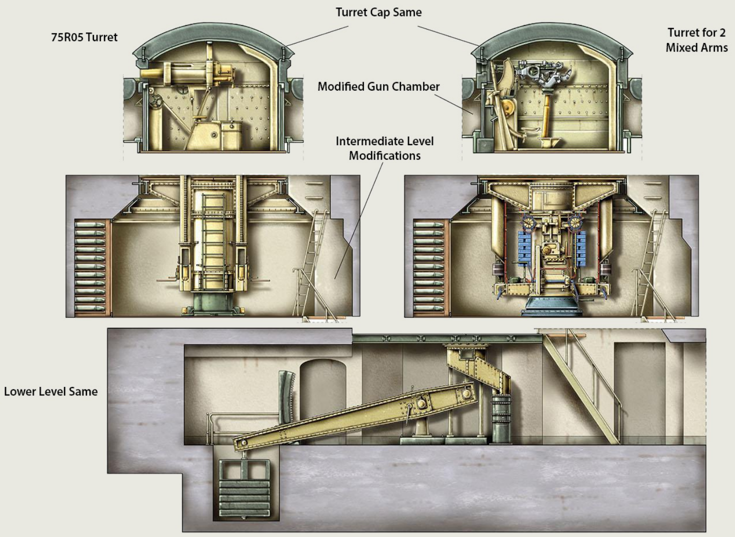


The gun compartment of the mixed-arms turret at *Ouvrage du Rohrbach*. Note the round gun cartridge loader in the centre and the 25mm anti-tank gun breech on top. (Collection: C.J. Vermeulen)

Model 75R05 for Two Mixed Arms	
Elevation in battery	1.03m
Shielding of the roof	28.5cm
Shielding of the wall	18.5cm
Total weight of the set	135 tons

Deployment and Current Status by Turret Mfg. Number	
553	P.O. Boussois, Bloc 2 – scrapped in 1941
560	P.O. Bersillies, Bloc 2 – scrapped in 1941
561	P.O. Eth, Bloc 2 – scrapped in 1941
562	P.O. Salmagne, Bloc 1 – scrapped in 1941
563	P.O. Les Sarts, Bloc 2 – scrapped in 1941
566	P.O. Haut-Poirier, Bloc 2 – in place
567	P.O. Welschoff, Bloc 2 – in place
568	P.O. Rohrbach, Bloc 1 – in place, refurbished
569	*Ouvrage du Thonnelle*, Bloc 4 – still in place without equipment
570	P.O. Vélosnes, Bloc 1 – scrapped in 1941
571	P.O. La Ferté, Bloc 2 – damaged in May 1940 – in place
572	*Ouvrage du Chesnois*, Bloc 1 – currently at the Musée de Fermont

G TRANSFORMATION OF A 75 R MODEL 05 TURRET TO A MIXED-ARMS MODEL 1934 TURRET


Turret Cap Same
75R05 Turret
Turret for 2 Mixed Arms
Modified Gun Chamber
Intermediate Level Modifications
Lower Level Same

The 75mm M1905 turret was used in the Séré de Rivières forts. Of the 73 turrets manufactured, only 57 were installed. The 16 remaining turrets were never delivered and most of them were placed in storage. In 1934 construction of the Maginot Line's 'New Fronts' was underway and the decision was made to re-use the stored 75R05 turrets. Twelve of the 16 were modified and installed in Maginot Line *ouvrages*. The modification included replacement and strengthening of the exposed segment of the gun chamber cylinder; replacement of the 75mm guns with two independently targetable mixed-arms weapons (each with two machine guns and one 25mm anti-tank cannon); and modifications to the intermediate turret level that included replacement of the shell hoists, turret controls, and counterbalance system to ease the raising and lowering of the guns. The lower level location of the turret cylinder counterbalance remained virtually unchanged from the original. The turret for two mixed arms was installed in Boussois, Bersillies, Eth, Salmagne, Les Sarts, Haut-Poirier, Welschoff, Rohrbach, Thonnelle, Vélosnes, La Ferté and Le Chesnois (Bloc 1).

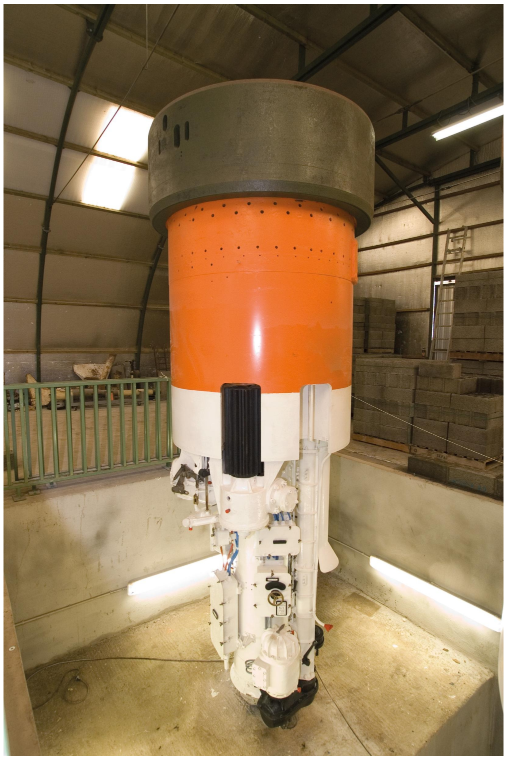
Machine-gun turret Model 1935 (TM)

The machine-gun turret was equipped with a pair of Reibel MAC 31 Type T machine guns. It was also equipped with a Type L644 scope for direct fire. The guns were cooled by a Vermorel sprayer affixed to the lower part of the turret. A copper pipe led from the sprayer into the firing chamber to a nozzle to spray the machine-gun barrels to prevent overheating during sustained fire.

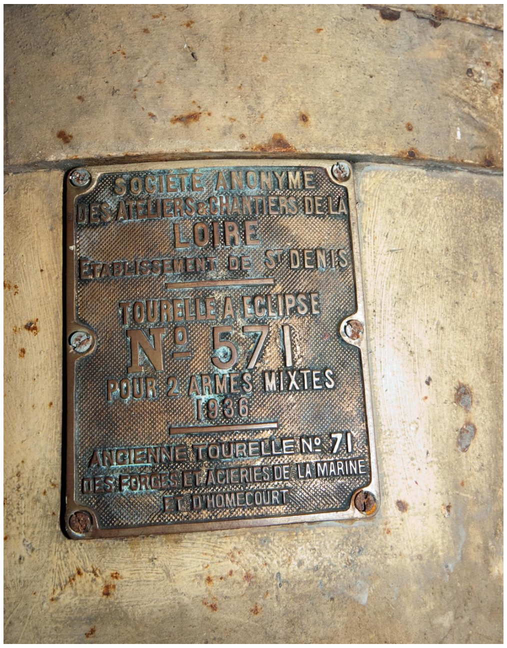
The M1935 turret crew included one NCO, one corporal, four machine gunners and one engineer. The turret was placed under the direct command of the infantry commander. Sixty-one machine-gun turrets were installed in the northeast.

Machine-Gun Turret Model 1935 (TM)	
Diameter of the upper cap	1.98m
Thickness of the roof	30cm
Thickness of the wall	30cm
Height emerging in battery	93cm
Total weight	95.9 tons

The cost of the machine-gun turret was about 1.6 million francs.



The machine-gun turret on display at Fermont Museum. This came from *Ouvrage du Molvange*. (Collection: C.J. Vermeulen)


SOCIETE ANONYME
DES ATELIERS & CHANTIERS DE LA
LOIRE
ETABLISSEMENT DE St DENIS
TOURELLE A ECLIPSE
No 571
POUR 2 ARMES MIXTES
1936
ANCIENNE TOURELLE No 71
DES FORGES ET ACIERIES DE LA MARINE
ET D'HOMECOURT

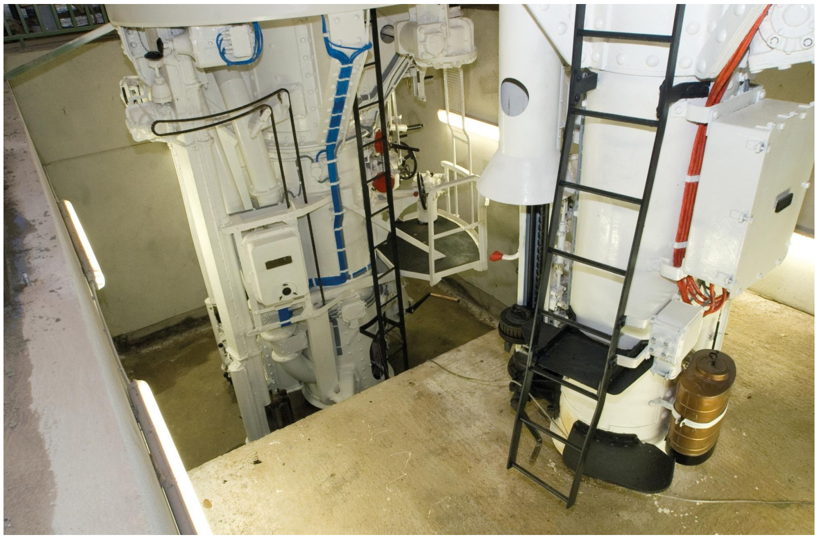
A plaque affixed to turret 571 at *Ouvrage de La Ferté*. The manufacturer was *Ateliers et Chantiers de la Loire*. It was originally built as turret 71 and the 5 was added after modification in the 1930s. (Collection: C.J. Vermeulen)

Deployment of Turrets by Fortified Sector

Fortified sector	75R32	135	75/33	75R05	81	T2AM	T2+M50	MG	Total
Escaut	–	–	–	–	–	1	1	–	2
Maubeuge	–	–	–	–	–	4	5	–	9
Montmédy	–	–	1	1	–	4	–	–	6
Crusnes	–	1	3	–	3	–	–	10	17
Thionville	6	6	5	–	6	–	–	18	41
Boulay	2	4	4	–	5	–	1	17	33
Faulquemont	–	–	–	–	–	–	–	6	6
Sarre	–	–	–	–	–	1	–	–	1
Rohrbach	1	2	1	–	4	2	–	5	15
Vosges	1	1	1	–	1	–	–	2	6
Haguenau	2	2	1	–	2	–	–	3	10
Dauphiné	–	–	1	–	–	–	–	–	1
Alpes-Maritimes	–	1	4	–	–	–	–	–	5
Total	12	17	21	1	21	12	7	61	152

OPERATIONAL HISTORY

Performance of Maginot Line guns, September 1939–June 1940



The machine-gun turret on the right. Note the Vermorel water sprayer container in brass and the black circular bullet cartridge case below the lift next to the ladder. The 75R32 turret is in the background. (Collection: C.J. Vermeulen)

The Maginot Line was successful in repelling German assaults where there was the greatest concentration of artillery pieces. Where they were not so concentrated, the forts did not fare well. Between the infantry fort of Chappy in the Crusnes Fortified Section and the large artillery fort of Anzeling west of Metz, there were 59 75mm cannons, 38 of which were under turrets (the rest in casemate); 25 135mm howitzers with 22 in turrets; and 34 81mm mortars, 28 in turrets. Between *Ouvrage du Simserhof* and *Ouvrage du Schoenenbourg* there were 24 75mm with 14 in turrets; 14 135mm with ten in turrets; and 17 81mm mortars, 14 in turrets. True, a small number of guns for such a long front, but quality compensated for quantity.

The guns were quite active during the period of the ‘Phoney War’, between September 1939 and May 1940, firing in support of minor French operations and patrols. German probes along the border in Alsace were easily repelled but the Germans had no intention of mounting any large operations at the time.

On 9 September 1939 *Ouvrage du Hochwald*'s 75mm turret, located in Bloc 7bis fired for the first time. After a few rounds were fired one of the barrels jammed. The team made up for the loss of the one gun by doubling the cadence of its mate. After the ceasefire order was given, an investigation was launched, which revealed that the ammunition was faulty. This was later confirmed after an identical accident occurred in a turret of the same type using the same model shells.

Testing continued over the winter of 1939–40. In January 1940, all tests on the 75mms went well; for the 135mms, however, only one-third of the shells exploded on impact. The others ricocheted on the frozen ground, and were found far from the point of impact. Close inspection revealed the fuses were damp and required replacement. Up to this point the 81s had not yet fired. Schoenenbourg's 81mm turret functioned properly after several breakdowns of the lifts; Hochwald's required a complete adjustment of the gas pressurization cylinders of one of the barrels (see section on 81mm mortar). One barrel fired 2,000m, the other only 800m. This revealed the need for monthly testing.

On 10 May 1940, the Germans invaded Luxembourg and in a couple days they were on the move into France. Light French cavalry forces were easily pushed back. During the night of 11/12 May the French situation deteriorated and by 0800hrs the leading elements of the German 17 Infantry Division appeared on the hills overlooking the industrial town of Longwy. They also appeared for the first time in the scopes of the Maginot Line observers. On 13 May observers at *Ouvrage du Latiremont* (Fortified Sector Crusnes) spotted German infantry moving along the main highway south of Longwy. The Germans had now come within range of the Maginot Line's guns.

On 12 and 13 May, German Panzers crossed the Meuse in the Ardennes. 1st, 2nd and 10th Panzer Divisions moved south to attack the weakly held line of defences at Sedan while 5th and 7th Panzer Divisions headed due west towards Maubeuge. The latter came up against weak border defences that consisted of small infantry and anti-tank blockhouses but no artillery pieces. In a matter of hours, despite the French crews putting up a good fight, the Panzers broke through and enveloped the fortified sector of Maubeuge from the south. The attack on Maubeuge began with a heavy artillery barrage against the southern line of casemates. This sector had four of the later-model forts but they carried no artillery pieces, only the mixed-arms turrets, which could not keep the Germans from approaching. They used the 88mm anti-air gun to fire on the embrasures and the observation cloches of the casemates. After their initial breakthrough, they turned the guns on the four infantry forts. A combination of concentrated fire from 88mm and 150mm shells and attacks by pioneers on top of the forts destroyed each of the turrets. Ventilation shafts were a prime target; their destruction trapped smoke and fumes inside the forts and they were forced to surrender over the next couple of days.

After the collapse of Sedan, the German 71 Infantry Division moved along the Chiers River defences on the Belgian border which had been abandoned by the French. The small *Ouvrage de La Ferté* was the westernmost fort of the Montmédy fortified sector. It was another fort that was built after 1934. It also had no artillery pieces and the closest support came from the 75R05 turret of *Ouvrage du Chesnois*, located 8km away at the very edge of its range. Chesnois provided fire support on numerous occasions, dropping shells on top of La Ferté but it was not enough to keep the German pioneers from accomplishing their mission. The small German squad approached the cloche of Bloc 2 and attached an explosive to the north embrasure then ran for cover from the explosion. The next target was the mixed-arms turret, already jammed in the raised position by earlier German shelling. A 40kg charge was affixed to the top of the turret. The explosion lifted the turret cap. A smaller charge was placed on the side of the turret and this explosion lifted the turret out of its socket and dislodged it at an angle that left a small opening to the inside of the turret bloc. The pioneers tossed grenades, smoke pots and explosives through the opening. The crew inside was defenceless and the lower tunnels quickly filled with smoke and fumes. The French gas masks were useless and over the next few hours the fort grew completely silent; a few days later it was determined that the entire crew had died from the fumes. The fall of La Ferté was a huge propaganda victory for the Germans – they had captured a fort of the Maginot Line. But it once again showed the devastating results of the decision to leave the fort without any artillery weapons or to keep it within range of adjacent support.

The actual turret of *Ouvrage de la Ferté*, destroyed by German pioneers on 18 May 1940. (Author's collection)

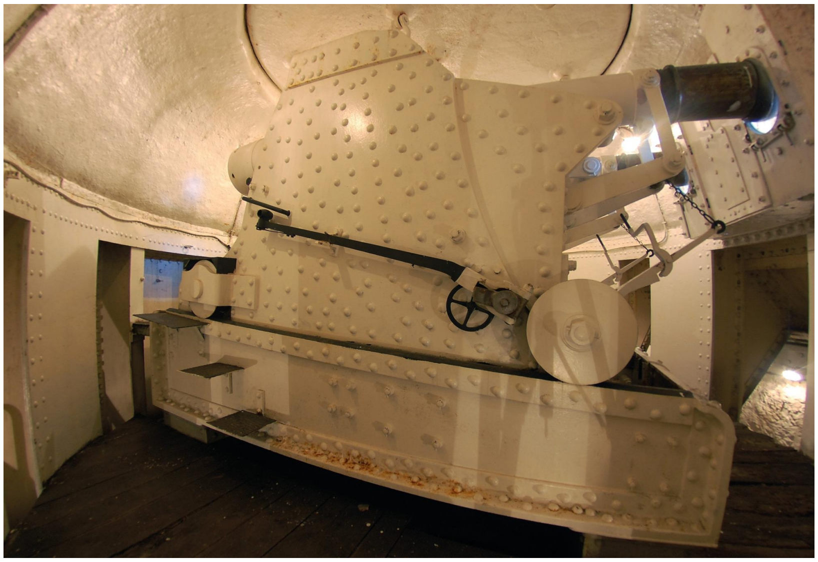
Around 6 June the Germans began their second phase of the campaign against France and quickly moved to roll up the French armies, pushing them further and further east. As France's strategic situation deteriorated, General Weygand, the French commander-in-chief, decided to pull regular infantry troops back from the Maginot Line and use them in the field. This included the fortress troops. Beginning on 13 June the crews were ordered to destroy the forts and march to the south. Over the next few days when this terrible action was to have taken place, the Germans were in the process of surrounding the Maginot Line from the rear, thanks to its evacuation by the bulk of the defenders. As a result, the destruction and evacuation order was stayed and the fortress troops, now left on their own, were ordered to fight on to the end and hopefully tie down German troops in the process.

On 15 June, the 75/33 turret of *Ouvrage du Fermont*'s Bloc 1 opened fire with explosive rounds at maximum cadence on a large convoy of the 183 Infantry Division attempting to outflank the line from the west. The inside of the turret became hot as a furnace as the shells were loaded non-stop into each gun as fast as they could be brought up the lift from below. Target after target was hit. The turret was retracted to cool off the guns and to check its calibrations, then it was raised again and the guns opened fire. By the end of the day the Germans had given up their plans to move in that direction and sought alternative routes on the back roads, out of the range of Bloc 1.

The invasion of southern France by the Italians is rarely discussed in relation to the Maginot Line; not many people know there were Maginot Line defences built in the south. But hundreds of positions were constructed beginning in 1928 and the system here worked marvellously, as it was intended. True, the nature of the mountainous terrain made up for reduced manpower, but everywhere the Italians appeared they were spotted and hit within minutes by French turret, casemate and field guns. The *Ouvrage du Roche-la-Croix,* located in the Dauphiné fortified sector, was in action almost continuously from 21 June to 25 June 1940. The fort's 75/33 turret fired almost continually on large masses of Italian troops attempting to capture the French border outposts. In all cases the enemy troops were stopped in their tracks.

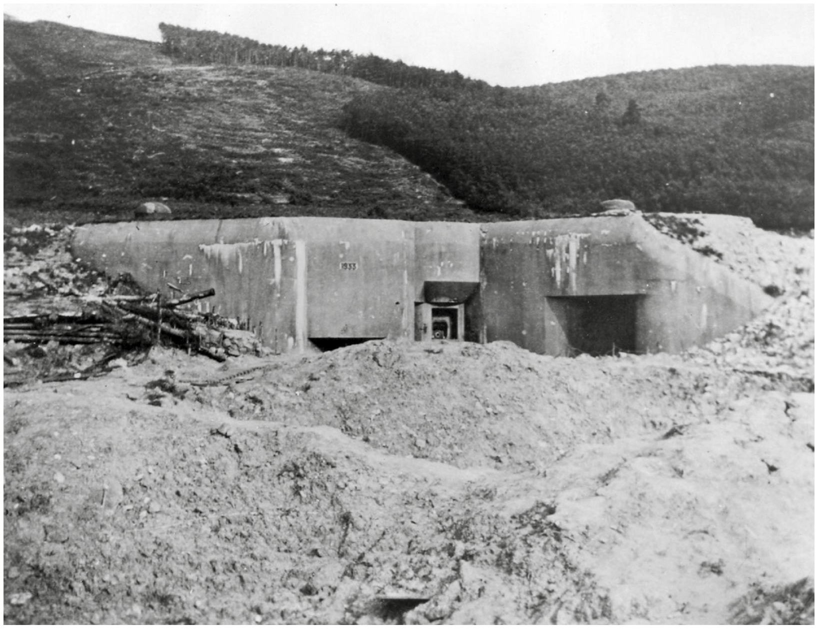
The Italians also attempted to break through in several locations in the Alpes-Maritimes sector. The artillery forts struck Italian columns heading towards the mountain passes that led into France. They were immediately hit and dispersed by the shells of *Ouvrage du Monte-Grosso*. On 24 June the 75mm turrets of *Ouvrage d'Agaisen* and Monte-Grosso fired about 3,500 rounds and were hit by 149mm, 210mm and possibly 380mm guns in return, 2,000 on Agaisen and 3,000 on Monte-Grosso, the most bombarded of all the *ouvrages* in the Alps. One shell struck and dented the cap of Monte-Grosso's 75/33 turret but that was the extent of the damage.

Along the Mediterranean coast, the Italians launched Operation 'R' to capture the southern coastal roads and advance quickly to Nice and Marseille. The two 75/33 turrets of *Ouvrage du Mont-Agel* opened fire. All of the passages across the frontier came under heavy harassing fire and the Italians were forced to turn back. On 23 June, enemy activity was spotted on the Massif du Razet and the turrets of *Ouvrage du Barbonnet* countered all enemy infiltrations. Monte-Grosso's and Agaisen's 75mm turrets also provided support. On 25 June, the armistice went into effect. In the Alps, the crews of the Maginot Line could claim almost total victory against the Italian invaders.



Interior of the gun compartment of the Mougin *Tourelle Jeanne d'Arc* at *Fort du Barbonnet* in the Alps showing the two 155mm Bange Model 1877 cannons mounted on two Saint-Chamond gun carriages. (Vaubourg Collection – **www.fortiffsere.fr**)

Back in the northeast, on 19 June the German 215 Infantry Division attacked in the Vosges to break through a thin line of casemates and blockhouses, none of which were equipped with artillery. The 75R32 turret Bloc 2 of *Ouvrage du Four-à-Chaux* could not reach the location of the main axis of attack. *Hochwald-Ouest*'s 135mm turret in Bloc 14 could reach only as far as *Ouvrage du Lembach*, completely out of range of the German attack zone. When the Germans appeared in range, however, the turret and casemate guns struck accurately and with deadly effect. The Germans broke through in the Vosges and swept east to surround the *Secteur Fortifié d'Haguenau*.



Bloc 1 of *Ouvrage du Hochwald* showing damage from Luftwaffe bombs. (Author's collection)

The attack on the Vosges included Luftwaffe air strikes on the casemates as well as the nearby artillery forts. The 75mm turrets in SF Haguenau had the capability to fire anti-aircraft rounds. The guns were set in the mode of high angle raking fire to cover a vertical space 100m x 100m. This action forced the Stukas to operate above an altitude of 500m, making their bomb runs less accurate. Stukas attacked Schoenenbourg and Hochwald (Bloc 6 and the casemates). The 135mm turret of Hochwald-Est fired anti-aircraft shells and Bloc 4 of Schoenenbourg succeeded in driving the Stukas to a higher elevation. The Stukas attacked Hochwald-Est, and Schoenenbourg fired anti-aircraft rounds at an altitude of 200m. The Stukas dropped bombs on Bloc 1 and 7bis but, due to the anti-aircraft fire coming from the turrets, they were less accurate.

Hochwald was hit by the following artillery and air strikes:

- 160 bombs of which 54 were 500kg or more, 106 medium and small (100 and 50kg)
- 50 shots from 420mm
- 33 shots from 280mm
- 3,000 of 105mm and 150mm.

All of the blocs except for B2 (TM) were hit by bombs or 420mm.

Further west the guns of *Ouvrage du Fermont*, in particular the 75/33 turret with a range of 11,900m, continued to harass German troops. As a result, General Hermann Wilck, commander of 161 Infantry Division, decided to capture the fort. The attack kicked off on 21 June with a heavy artillery bombardment that included the 305mm mortars of *Schwere Artillerie Abteilung* 641. Three batteries of 210mm mortars, six 105mm, two 88mm and several Pak 37s and 47s were part of the artillery contingent. The mission of the German pioneers was to attack the turrets and cloches with explosive charges as they had done at La Ferté. 37mm and 47mm guns were moved up from the *Bois de Beuville* to the edge of the anti-tank rails behind Fermont's entrance bloc. The shells exploded on the concrete but did not cause any damage. The gunners inside the blocs were ordered to move away from the turret of Bloc 1. The large-calibre shells continued to strike the turret cap but caused no damage. The shelling ended and the assault troops moved forward, but the attack was stopped when all of Fermont's and neighbouring Latiremont's turrets raised up in battery and opened fire, much to the shock of General Wilck. Unable to move forward, he called off the attack.

The mixed-arms turret of *Ouvrage du Haut-Poirier*. (Author's collection)

The *ouvrages* with no artillery support did not fare well at all. In *Secteur Fortifié de Faulquemont*, German troops from 339 Infantry Regiment, after blinding the observers and suppressing the infantry turrets, successfully attacked and captured *Ouvrage du Bambesch* and *Ouvrage du Kerfent*. In *Secteur Fortifié de Rohrbach*, 262 Artillery Regiment set up 15cm guns to target *Ouvrage du Haut-Poirier*. Because of the configuration of the fort, the mixed-arms turret was useless against targets to the rear. The crew of Haut-Poirier watched helplessly as thousands of German troops moved unmolested along their left flank and occupied the villages behind the line. There was no way to stop them. Around 1500hrs the guns opened fire on Bloc 3; the fort was systematically destroyed and surrendered on 21 June. From there the Germans moved on to the neighbouring *Ouvrage du Welschoff* and it suffered the same fate.

General Sixt von Arnim decided to attack and capture *Ouvrage du Michelsberg* in *Secteur Fortifié de Boulay*. German reconnaissance patrols were sent out on the afternoon of 21 June to test French resistance. As German troops approached the rear entrance of Michelsberg, Bloc 3, equipped with an 81mm turret, dropped three salvoes of 54 shells into the trees of the nearby woods. The 135mm turret of Bloc 6 fired eight shots. Several Germans were wounded and killed. On 22 June, General von Arnim's troops began the attack. The main German forces were concentrating in the nearby village of Dalstein which was struck by the turrets of Michelsberg. Soon the adjacent forts of Mont des Welches, Hackenberg and Anzeling joined in. Mont des Welches' cannons concentrated on the *Bois de Klang* to the west. Anzeling's 75/33 turret in Bloc 4 scoured the road near Volmerange and went after German infantry near Dalstein. Michelsberg's guns pounded the rear of the *ouvrage*, severely hampering the German concentration. The Germans fired another 500 shells on Mont des Welches and 160 on Michelsberg; however the Maginot Line guns were too powerful, responding to every threat almost instantaneously, and their range would not allow the Germans to concentrate their forces for a successful attack. It was also impossible to set up an 88mm battery within 1,000m where it would do the most damage. In light of the day's events, von Arnim called off the attack. That evening an order was sent out to the divisions of Army Group C forbidding any further attacks against the forts of the Maginot Line.

Despite intense shelling by heavy guns and aircraft the Maginot Line artillery gun turrets suffered little to no damage. On 22 June, the 75R32 turret in Schoenenbourg's Bloc 3 was hit with a 105mm shell. The fragment impeded the full lowering of the turret and it was removed overnight. The group commander ordered the turrets to be very selective with their targets and not to expose themselves to unnecessary damage or respond to non-urgent requests.

The Germans also tried to destroy the forts, as they had done in the previous war, with heavy artillery. The forces of *Schwere Artillerie Abteilung* 800 concentrated 105mm, 150mm and 420mm guns on Schoenenbourg. The 420mm fired 14 shots – one every seven minutes. Bloc 3's turret was hit by a shell on the fore-armour but the damage was minor – a few small cracks. One 420mm shot knocked off the vent stack of Bloc 6 and flung it 50m in the air. Another shell fell within two metres of the turret of Bloc 3 and broke off a small chunk of concrete but the steel wedges of the armoured collar were left intact.

The Maginot Line artillery turrets continued to fire all across the line until the very moment the armistice ceasefire went into effect at 0035hrs on 25 June 1940.

ANALYSIS

It is this author's opinion that the Maginot Line has been the subject of much 'bad press'. Sadly, for the past 75 years, it has been identified as a symbol of defeat. The primary role of the line was to prevent a concerted attack on France through the traditional invasion routes and to permit time for the mobilization of troops. This mission was fulfilled. Second, in case of an enemy invasion it would allow the French to fight on favourable terrain and to force the enemy to skirt the line and move through Belgium or attack the line directly. Unfortunately for France, General Gamelin, Weygand's predecessor, chose to do exactly what the Germans expected him to do – move his best armies into Belgium instead of using the fortifications as a place from which to launch attacks.

But that is the strategic verdict. Regarding the turrets, their operational performance and the accuracy of target strikes was excellent. The time from the first sighting of a target by an observer to a shell being fired on target was about three minutes. This speaks to the excellent command and control system and training of the gun crews and observers. German officers who visited the forts after the armistice remarked about the exceptional performance of the crews and the accuracy of the guns; some remained quite angry about it. Captain Von der Heide of 246 Infantry Division, an Austrian from an old French family, gave an account of the final German combat. He was at the head of an assault on one of the French advance posts in Alsace. His men were continuously menaced by the turrets of Schoenenbourg and they jumped into the trenches to escape the effects. Another visitor, who even the German liaison agreed was rude to his French hosts, continually scowled at the French escort. Afterwards he apologized for his behaviour and recounted that he was in charge of a patrol that had been decimated by the French guns, with heavy losses. Stuka pilots visiting Hochwald could not believe how little damage their heavy bombs had inflicted on the fort, the way that the guns had been able to continue to fire, and how there was no serious damage to the concrete and steel.

The 75mm and 135mm turrets fired thousands of shells on targets to the north, south, east and west, and in most cases stopped the Germans dead in their tracks. The Germans broke through the line where it was either void of interval troops or artillery pieces; what would prove to be the major flaws of the execution of the Maginot Line.

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ABOUT THE AUTHOR

Clayton Donnell has had a lifelong fascination with the fortifications of the Western Front. He spent his early years living in Belgium, and often visited the sites of the Brialmont forts. Over the years he has amassed a large collection of material relating to this period, and has translated much of it from French to English. He has previously co-written *Modern European Military Fortifications, 1870–1950: A Selected Annotated Bibliography* (Praeger, 2004), and has written *Breaking the Fortress Line 1914* (Pen & Sword, 2013), and three books in the Fortress series for Osprey: *The Fortifications of Verdun 1874–1917*, *The Forts of the Meuse in World War I*, and *The German Fortress of Metz 1870–1944*.

ILLUSTRATOR

Donato Spedaliere was born in Lausanne, Switzerland, and moved to Tuscany, Italy, at the age of ten, where he still lives today. He has studied in Florence, and served in the Italian Army as a paratrooper. Since 1995, he has worked as a professional freelance illustrator for publishers in Italy and abroad. His artworks are to be found in many books, encyclopaedias, magazines, and museum collections. He is also a 3D artist, specialising as a matte painter, concept designer and CG generalist.

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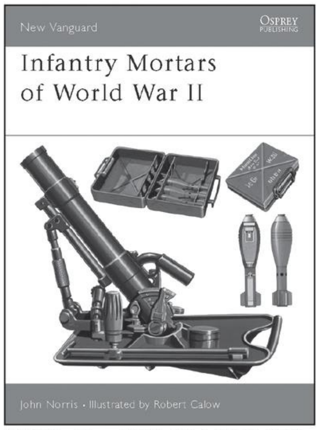
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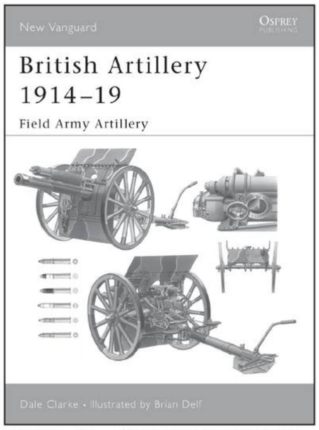
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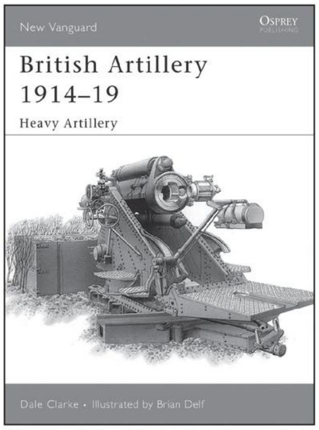
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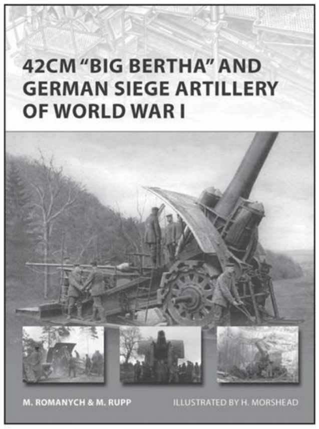
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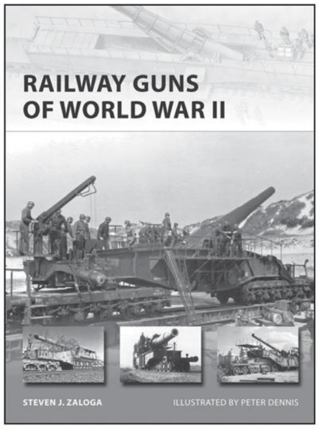
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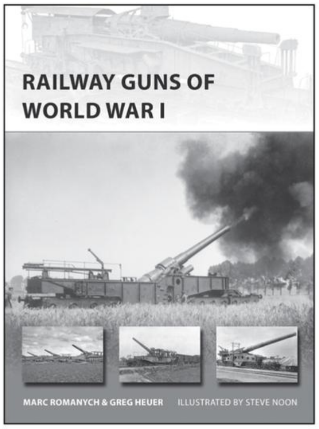
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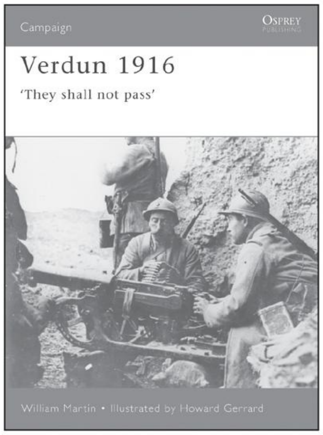

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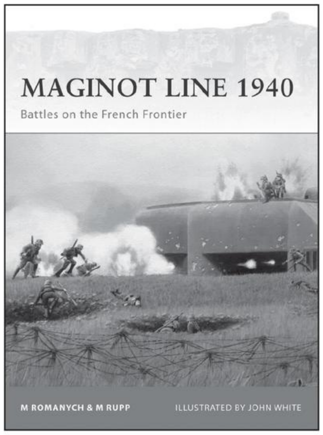

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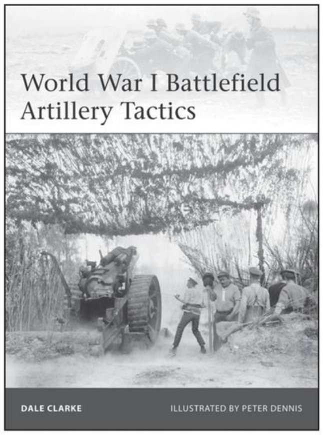

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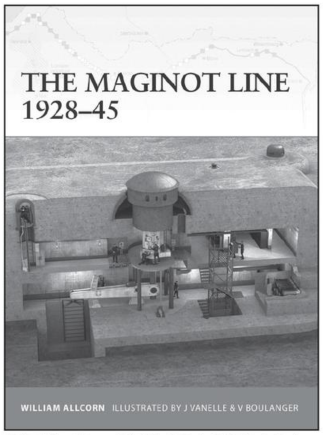

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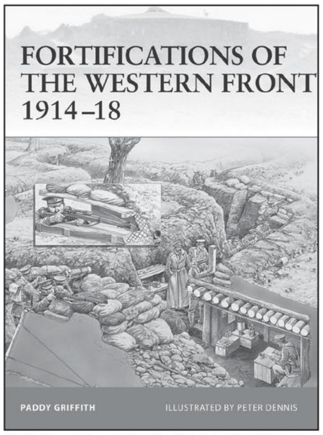

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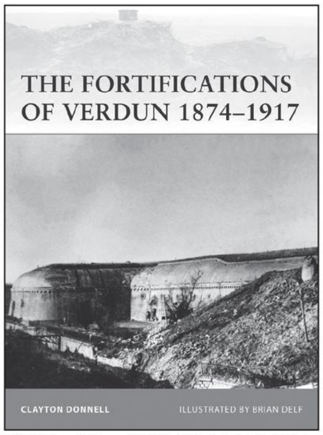

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AUTHOR'S NOTES

The French army chose the term *'ouvrage'* rather than the more familiar 'fort'; therefore I have used the French term throughout the book, for example, *Ouvrage du Schoenenbourg*, rather than Fort Schoenenbourg. An infantry *ouvrage* was also referred to as a 'small' or *Petit Ouvrage* (P.O.). The compartment in which the turret was housed is referred to as a 'bloc' so as not to confuse it with a casemate, which is a different structure. A combat bloc – infantry or artillery – is connected, in nearly all instances, with the rest of the *ouvrage*. Observation posts are given the name *'cloche'*. It is a French term for a bell, but the word *cloche* also exists in an English form.

ARTIST'S NOTE

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